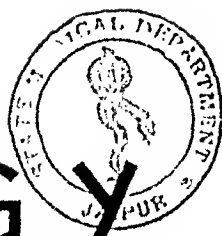


RADIOLOGY



A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

EDITOR

Howard P. Doub, M.D.
Detroit, Michigan



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JANUARY 1946

No. 1

CONTENTS

- SUPERFICIAL "BURNS" OF SKIN AND EYES FROM SCATTERED CATHODE RAYS.
*Laurence L. Robbins, M.D., Joseph C. Aub, M.D., Oliver Cope, M.D.,
David G. Cogan, M.D., John L. Langohr, M.D., R. W. Cloud, M.S.,
and Oliver E. Merrill, B.E.E.* 1
- ROENTGENOLOGY OF THE DRAINING BRONCHI FROM TUBERCULOUS CAVITIES.
Mortimer R. Camiel, M.D. 24
- A STUDY OF THE URETERS IN BLADDER NECK OBSTRUCTIONS.
Fay H. Squire, M.D., and Herman L. Kretschmer, M.D. 32
- DIAGNOSIS OF PES PLANUS BY X-RAY.
Capt. Wm. L. Bonnet, M.C., and Capt. D. R. Baker, M.C., A.U.S. 36
- PNEUMOCONIOSIS DUE TO COTTON DUST (BYSSINOSIS). A CASE REPORT.
*Lt. Col. Paul V. McCarthy, M.C., and Lt. Col. Walton R. Akenhead,
M.C., A.U.S.* 46
- AN UNUSUAL CASE OF MULTIPLE CHONDROMATA.
Maj. Ramsdell Gurney, M.C., and Capt. Louis Cohen, M.C., A.U.S. 48
- ROENTGENOGRAPHIC DEMONSTRATION OF CONCRETIONS IN THE SUBMAN-
DIBULAR GLANDULAR DUCT BY USE OF INTRAORAL FILMS.
George D. Monardo, R.T. 53
- PROTECTION AGAINST X-RAYS AND GAMMA RAYS.
*Standardization Committees of the American Roentgen Ray Society and the
Radiological Society of North America* 57
- EDITORIAL: LOWELL S. GOIN, M.D. *R. R. Newell* 77
- ANNOUNCEMENTS AND BOOK REVIEWS. 80
- RADIOLOGICAL SOCIETIES OF NORTH AMERICA. 83
- ABSTRACTS OF CURRENT LITERATURE. 85

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FEBRUARY 1946

No. 2

CONTENTS

- THE ROENTGEN ANATOMY OF THE SKULL IN THE NEWBORN INFANT.
Samuel G. Henderson, M.D., and Louise S. Sherman, M.D. 107
- MID-LINE ANOMALIES OF THE BRAIN: THEIR DIAGNOSIS BY PNEUMO-
ENCEPHALOGRAPHY.
Arthur P. Echternacht, M.D., and John A. Campbell, M.D. 119
- LESIONS OF THE AQUEDUCT OF SYLVIVS.
Hugh M. Wilson, M.D., and Walter G. Lutz, M.D. 132
- OBSERVATIONS ON THE PRESENCE OF SUBDURAL GAS AFTER PNEUMO-
ENCEPHALOGRAPHY. *L. W. Paul, M.D., and T. C. Erickson, M.D.* 139
- THE TREATMENT OF LATE POST-IRRADIATION ULCERS WITH RADON OINT-
MENT. *Bertram V. A. Low-Beer, M.D., and Robert S. Stone, M.D.* 149
- THE TREATMENT OF HEMANGIOMA. *G. E. Pfahler, M.D., Sc.D., LL.D.* 159
- THE VALUE OF STEREOSCOPY IN MASS RADIOGRAPHY OF THE CHEST.
Ira Lewis, M.D., and Russell H. Morgan, M.D. 171
- A COMPARISON OF TWO LEVELS OF ROENTGEN AND NEUTRON IRRADIATION
OF NORMAL AND LYMPHOMATOUS MICE, USING RADIOPHOSPHORUS AS
AN INDICATOR OF CELLULAR ACTIVITY. *K. G. Scott, A.B.* 173
- SOME OBSERVATIONS ON X-RAY TREATMENT CONES.
C. E. Eddy, D.Sc., and D. J. Stevens, B.Sc. 176
- EDITORIAL: THE LATENT PERIOD WHICH ELAPSES BETWEEN THE ONSET
OF A LESION AND THE APPEARANCE OF RADIOGRAPHIC SIGNS.
James F. Brailsford, M.D. 184
- ANNOUNCEMENTS AND BOOK REVIEWS. 186
- RADIOLOGICAL SOCIETIES OF NORTH AMERICA. 189
- ABSTRACTS OF CURRENT LITERATURE. 191

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CONTENTS

THE ROENTGENOGRAPHIC SIGNS OF HERNIATION OF THE CERVICAL INTER- VERTEBRAL DISK. <i>J. E. Whiteleather, M.D., R. E. Semmes, M.D., and Lt. Col. Francis Murphey, M.C.</i>	213
ROENTGENOGRAPHIC OBSERVATIONS IN AGE ATROPHY AND OSTEOPOROSIS OF THE SPINE. <i>Gottlieb J. Marum, M.D.</i>	220
REFLEX HYPEREMIC DEOSSIFICATIONS REGIONAL TO JOINTS OF THE EXTREMITIES. <i>Col. Alfred A. de Lorinier, M.C., William L. Minear, M.D., and Harold B. Boyd, M.D.</i>	227
NON-DISABLING BRONCHIECTASIS. <i>Major Archie Fine, M.C., and Capt. T. B. Steinhausen, M. C.</i>	237
ROENTGENOGRAMS OF THE CHEST IN MENTAL DEFICIENCY. <i>Joseph T. Danzer, M.D.</i>	244
THE ROENTGENOGRAPHIC APPEARANCE OF TEMPOROMANDIBULAR HYDRAR- THROSIS. <i>Capt. Arnold L. Bachman, M.C., and Lt. Col. Albert L. Bershon, M.C.</i>	251
TRANSIENT SUCCESSIVE PULMONARY INFILTRATIONS (LÖFFLER'S SYN- DROME). <i>Max Eichwald, M.D., and William V. Singletary, M.D.</i>	258
UNUSUAL BONE LESIONS IN AN INFANT, PROBABLY OSTEITIS TUBERCULOSA MULTIPLEX CYSTOIDES. <i>F. Y. Khoo, M.D., and Y. Yang, M.D.</i>	263
CONGENITAL ABSENCE OF THE ODONTOID PROCESS. <i>Major Jos. McK. Ivie, M.C.</i>	268
CONGENITAL ABSENCE OF THE SEPTUM PELLUCIDUM ASSOCIATED WITH INTERNAL HYDROCEPHALUS. <i>William P. Savain, M.D.</i>	270
MARCH FRACTURE OF THE ARTICULAR SURFACE OF THE TIBIA AND ITS RELATION TO OSTEOARTHROPATHY. <i>Lt. Col. Joseph Levitin, M.C.</i>	273
FATIGUE FRACTURE OF THE METATARSAL. <i>Major William E. Allen, Jr., M.C.</i>	276
CANCER OF THE SKIN: A STATISTICAL REPORT. <i>Henry J. Ullmann, M.D.</i>	279
EDITORIAL: PRESIDENTIAL ADDRESS. <i>Lewis G. Allen, M.D.</i>	282
ANNOUNCEMENTS AND BOOK REVIEWS.	286
RADIOLOGICAL SOCIETIES OF NORTH AMERICA.	288
ABSTRACTS OF CURRENT LITERATURE.	290

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No. 4

CONTENTS

ROENTGEN CHANGES ASSOCIATED WITH PANCREATIC INSUFFICIENCY IN EARLY LIFE.	<i>Edward B. D. Neuhauser, M.D.</i>	319
THE ROENTGEN DIAGNOSIS OF PANCREATIC CYST.	<i>John F. Holt, M.D.</i>	329
CONGENITAL DUODENAL OBSTRUCTION. REPORT OF SIX CASES AND REVIEW OF THE LITERATURE.	<i>Friedrich G. Kautz, M.D., James R. Lisa, M.D., and Ernest Kraft, M.D.</i>	334
DIVERTICULOSIS OF THE JEJUNUM AND ILEUM.	<i>Max Ritvo, M.D., and Paul J. Votta, M.D.</i>	343
PELLEGRINI-STIEDA DISEASE.	<i>Capt. Delbert A. Russell, M.C., A.U.S., and Lt. Col. Charles D. Smith, M.C., A.U.S.</i>	351
SPONDYLOLISTHESIS. FURTHER REMARKS WITH EMPHASIS ON RADIOLOGIC ASPECTS.	<i>Major A. C. Galluccio, M.C., A.U.S.</i>	356
ENERGY ABSORPTION IN THE TRUNK IN THE RADIUM TREATMENT OF BREAST CANCER BY INTERSTITIAL AND SURFACE APPLICATOR METHODS.	<i>C. W. Wilson, M.Sc., Ph.D.</i>	364
HENOC'S PURPURA: SMALL INTESTINAL CHANGES. CASE REPORT.	<i>Capt. Wm. H. Whitmore (MC) U.S.N. (Ret.), and Lt. Gerald M. Peterson (MC) U.S.N.R.</i>	373
DYSGERMINOMA OF THE OVARY WITH WIDESPREAD METASTASES.	<i>Eugene P. Pendergrass, M.D., and Joseph Selman, M.D.</i>	377
ACCESSORY URETHRAL CHANNEL. CASE REPORT.	<i>Capt. E. E. Fong, M.C., A.U.S.</i>	380
A NEW METHOD OF MAKING RADON OINTMENT.	<i>L. Cardenas, E.E., and J. L. Weatherwax, M.A.</i>	381
PROTECTION MEASUREMENTS OF LEAD-SHIELDED RADIUM.	<i>Carl B. Braestrup</i>	385
PELVICEPHALOMETRY.	<i>Capt. Tom A. Kendig, M.C., A.U.S.</i>	391
STUDIES IN VITRO ON CELLULAR PHYSIOLOGY. THE EFFECT OF X-RAYS ON THE SURVIVAL OF CELLS.	<i>Major Robert Schrek, M.C., A.U.S.</i>	395
EDITORIALS: ACTA RADIOLOGICA.	<i>Leo G. Rigler, M.D.</i>	411
CYSTIC FIBROSIS OF THE PANCREAS.		412
ANNOUNCEMENTS AND BOOK REVIEWS.		414
RADIOLOGICAL SOCIETIES OF NORTH AMERICA.		418
ABSTRACTS OF CURRENT LITERATURE.		420

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PUBLISHED BY THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

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No. 1

Superficial "Burns" of Skin and Eyes from Scattered Cathode Rays¹

LAURENCE L. ROBBINS, M.D., JOSEPH C. AUB, M.D., OLIVER COPE, M.D., DAVID G. COGAN, M.D.,
JOHN L. LANGOHR, M.D., R. W. CLOUD, M.S., and OLIVER E. MERRILL, B.E.E.

Boston, Mass.

THE PRESENT report is concerned with varying degrees of injury received by six men in the Department of Radiology at the Massachusetts General Hospital as a result of a few seconds' exposure to scattered electrons from a 1,200-kv. electrostatic generator. The main purpose in presenting this report is to prevent a repetition of that experience. It seems important also to emphasize the dangers inherent in scattered as well as in direct cathode rays, in order that the recurrent enthusiasm for their therapeutic possibilities may not be permitted to overshadow their possible harmful effects.

Reports of serious radiation injury to persons working with roentgen-ray generators are uncommon at the present time, although in the early days of roentgenology such reports were common. Those trained in the use of the roentgen ray have a definite respect for its latent injurious effects, and it is to be noted that relatively few radiation injuries are seen in this group. Most of the injuries which have occurred have been due to lack of training. In ret-

spect, therefore, the question arose as to whether an accident such as occurred in this hospital is excusable, whether all the possible dangers associated with cathode rays should have been appreciated by at least the senior members of the group. The effect of exposure to cathode rays in the direct beam was of course known (9, 10), but the effect of scattered cathode rays was not understood. The scattering was thought to be similar to the fluorescence of ionized air which is visible beneath the cathode ray port in a dark room (Fig. 1). Subsequent careful review of the medical literature has failed to reveal any reports of injuries due to scattered cathode rays. Numerous articles have dealt with the physical and the biologic aspects of these rays, a few with their use in the treatment of certain skin diseases, but only a rare publication has mentioned accidental injury due to them.

Jacobsen and Waddell (7) found that the effects of cathode rays on the skin of the rat were similar to those of roentgen rays, and that actually the effect of the

¹ From the Departments of Radiology and Surgery, Massachusetts General Hospital, the Medical Laboratories of the Collis P. Huntington Memorial Hospital of Harvard University at the Massachusetts General Hospital, the Howe Laboratory of Ophthalmology, Harvard University Medical School and Massachusetts Eye and Ear Infirmary, and the Massachusetts Institute of Technology. Accepted for publication in June 1945.

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Fig. 1. Photograph of the fluorescence of ionized air produced by a 3,000-kv. electrostatic generator. (The machine in use at this hospital is a 1,200-kv. generator.)

roentgen rays was due to cathode rays which originated in the tissues. Jacobsen (6) later confirmed these observations by experiments on the skin and testis of the white rat. Brasch (2) reported experiments on white mice and rabbits made in the direct beam with cathode rays generated at 2,500 kv., 1 ma., at 100 cm. distance. The mice died a few days after exposures of $1/10,000$ to $1/1,000,000$ second. These observations indicate that the effects of cathode and roentgen rays are similar, except that the former have a definite and limited depth of penetration without underlying reaction.

Wilhelmy (11), using cathode rays energized at approximately 210 kv., 1 ma., and a treatment distance of 5 cm., was able to produce an erythema with 1.2 second exposure. With this dosage, no epilation was observed. With 400 times the thresh-

old erythema dose, two definite reactions were noted, the first appearing almost immediately and the later or main reaction developing about thirty-five days after irradiation. Wilhelmy observed likewise that areas irradiated with cathode rays showed relatively little if any pigmentation, whereas those receiving treatment with roentgen rays showed characteristic pigmentation and telangiectasis. He believed that the effects of the two types of radiation were in the main similar and that any differences were due to the limited depth of penetration of the cathode ray.

In 1934, Brasch and Lange (3) experimented with cathode rays generated at voltages up to 3,000 kv. Their investigations indicated that damage due to overdosage from cathode rays was similar to that following roentgen irradiation. Summarizing the results of their work, they stressed the following essential characteristics of cathode rays: (1) limitation to a defined depth of penetration, (2) ability to transmit more energy to the depth than to the surface, (3) marked biologic effect, and (4) deflectability by magnets.

Baensch and Finsterbusch (1) reported the results of treatment with cathode rays in a few selected cases of lupus, psoriasis, poorly healing superficial lesions, eczema, and cancer. They mention the necessity of protection for the eyes to avoid irradiation of the conjunctiva and cornea. From their experiments they concluded that cathode rays have a remarkable power of healing in a number of skin lesions, but they also warn that considerable reaction usually follows this form of treatment. They state that a sufficient number of cases had not been treated to warrant drawing definite conclusions as to the types of lesions that would respond most satisfactorily.

Crawford (4) in 1933 reported an instance of injury from cathode rays. A review of the case history suggests that the injured physicist was within the direct beam, and Crawford himself states that the condition may have been complicated by the fact that a "Willemite" screen was

used. In this case a rather prompt erythema with edema appeared, and later bullae developed on the fingers. The original reaction healed in four weeks. The patient was followed for ten months, and at the time of the report showed numerous areas of telangiectasis with dryness and slight thinning of the cutis.

An unreported accident that occurred in 1935 was recently called to our attention. A physicist, working with a unit of construction and type similar to the one in use at this hospital, received injuries along the volar surface of the forearm and the inner surface of the arm, as well as some damage to several fingers. The injury to the forearm and arm could have been due to roentgen rays, as the extremity partially encircled a brass pipe which conducted the electrons from the tube to the target. The burns on the fingers, however, may well have been caused by exposure to cathode rays. Today, ten years after the injury was received, the scars of these burns show telangiectasis, skin atrophy, and lack of pigmentation, and are similar to the late changes following exposure to roentgen rays or radium. After the accident, this physicist made numerous experiments with cathode rays and became fully aware of the manner in which the electrons scatter as well as the means of protection, but unfortunately this material was not published in the medical literature.

An unconfirmed verbal report has it that several years ago a group of persons in Russia were exposed to cathode rays and received skin injuries. We have been unable, however, to find any published account of the incident detailing the exact means of exposure, the severity of the reactions, or the amount of permanent damage.

The majority of the publications on cathode rays are confined to experiments or therapeutic procedures carried out in the direct beam and give no definite information regarding the effect of scattered electrons. The energy involved in cathode rays is many times greater than that of

roentgen rays. This is more readily understood when it is realized that in the production of the latter probably only 0.5 per cent of the energy of the electron stream is converted into x-rays. It seems likely that the effect in the tissues superficial to the depth penetrated by cathode rays is similar to that of x-rays, as experiments have shown that the biologic effect of the latter is dependent upon the effect of cathode rays generated within the tissue.

Our experience with cathode rays is essentially in agreement with that of the various investigators referred to above.

THE EXPOSURE TO SCATTERED CATHODE RAYS

On Dec. 1, 1944, in the supervoltage treatment room at this hospital, the target had been removed from the tube of the 1,200-kv. electrostatic generator, and the cathode-ray window inserted in its place. This procedure had been undertaken because the focal spot had been wandering and quick determinations of its size and location were desired in order to correct the error. The necessary information could be readily obtained by inserting a piece of film beneath the cathode-ray window and burning a hole in it with very short exposure.

It was known, of course, that there was definite danger from the direct beam, but it was thought that, if a reasonable distance were maintained, there was no great danger in entering the room for a short period of time. Consequently, a group of six men—a staff member (*E*), the physicist (*B*), two residents in radiology (*A* and *C*), and two medical students (*D* and *F*)—went into the room while the machine was in operation. The entire time during which the machine was running was probably not longer than two minutes. Each of the six persons stood at least 3 to 5 or more feet away from the central beam, and at right angles to it. At one point all of them leaned down and for five seconds or less looked up at the cathode ray window to observe its fluorescence. *A*, *B*, and *C* stood approximately in the posi-

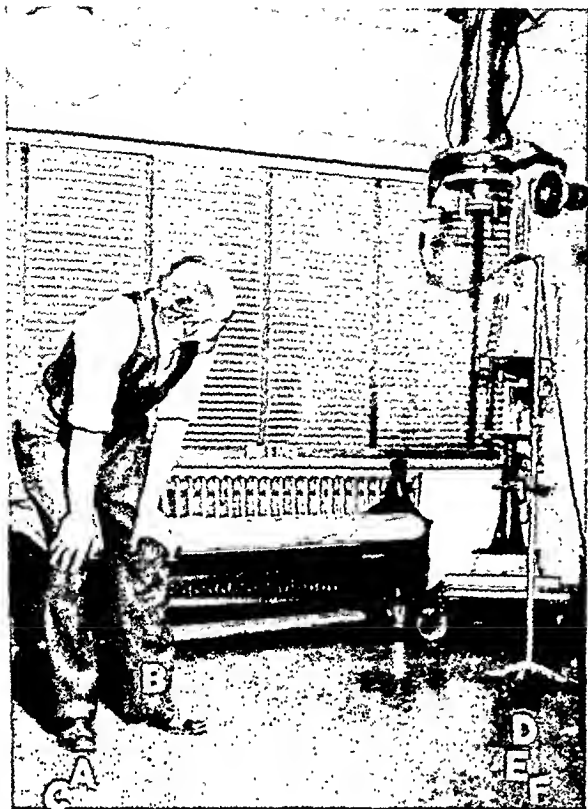


Fig. 2. The room as it appeared at the time of the accident. A, B, C, D, E, and F indicate the respective positions of the six men who were exposed to the cathode rays.

tion of the man in Figure 2; *D*, *E*, and *F* stood somewhat to the right and about the same distance away from the plane of the central beam. For an instantaneous period of time, *A* stepped considerably closer to the machine and pointed toward the cathode-ray window. He was immediately warned to stand back, and did so. (Whether or not during this instant he actually stepped into the direct beam is unknown. He undoubtedly received the most severe injuries of the entire group.) *A*, *C*, *D*, *E*, and *F* all left the room at the end of a period probably less than ten minutes and received no further irradiation. *B* had made two somewhat similar observations during the morning of the same day but was not in the room during the afternoon exposures to the scattered cathode rays.

EXTENT OF THE EXPOSURE

Ionization Measurements: Within a day or two of the accident it was realized that

approximate ionization measurements should be obtained in order to estimate the dose and the depth of penetration of the radiation received by those who were in the room. Likewise, it was necessary to exclude roentgen rays as a cause of the already apparent reactions. Inasmuch as the machine had been reassembled and was being used for supervoltage roentgen therapy, these measurements were delayed until Dec. 14. As nearly as possible, the actual conditions prevailing when the accident occurred were reproduced.

The source of radiation was a vertical 1,200-kv. cathode ray beam emitted through an 0.005-cm. thick aluminum window in the tube, which was 175 cm. above the floor. The diameter of the beam is about 1 cm. as it exits from the tube, but this is increased considerably farther from the tube due to scattering of the beam by air molecules. Previous measurements (9) indicate that the 0.005-cm. aluminum window stops only a small percentage of the electrons, and the maximum range of 1,200-kv. electrons is 5.4 mm. in water, and probably 450 cm. in air.

An estimation of the beam current in use at the time those who entered the room were exposed was made by trying to reproduce the burning effect on a piece of x-ray film. It was thus estimated that the beam current was about 50 microamperes, but it is realized that the estimate may be in error by a factor of two.

Measurements of ionization intensity in a phantom were made to obtain the ionization dose expected in the tissue of those who were irradiated. The phantom was located at about face level, 70 cm. downward from the portal and 100 cm. sideways from the center of the beam, and turned on its side so that depth was measured from the side nearest the beam. A thin ionization chamber (9) with an upper surface of 0.002 cm. cellophane was used so that measurements could be made very near the surface. The back of this chamber becomes part of the phantom.

A curve of "tissue roentgens" (5) vs.

depth in the phantom is included (Chart I). This shows that the intensity diminishes rapidly beyond 1 mm. in depth until it is practically zero at 3.1 mm. Thus the intensity of x-rays is negligible, since there is little ionization beyond the range of the cathode rays.

The Victoreen r meter with 100-r chamber attached, turned sideways to the beam, gave the same reading, within 10 per cent,

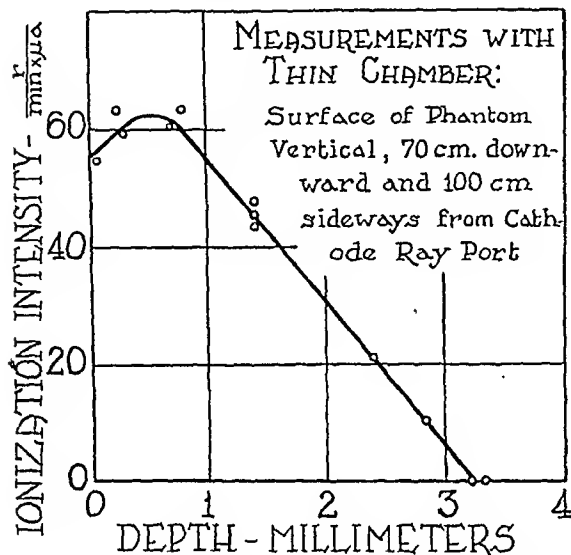


Chart I. Cathode ray intensity in e.s.u. per cubic centimeter per minute per microampere-beam current versus depth in phantom.

as the e.s.u. per cubic cm. in the thin chamber within 1 mm. of surface. Therefore, such Victoreen readings give skin dosage. Victoreen readings at various positions in the room are indicated on Chart II, the roentgens per minute per microampere-beam current being given by the numbers for the positions they occupy.

When a 5-mm.-thick lucite cap was placed over the Victoreen thimble the intensity was reduced to practically nothing, which indicated again that the x-ray intensity is very slight. Intensities in the beam of 11,000 r per minute per microampere were reduced by the cap to 0.28 r per minute per microampere, and at "B" (see Chart II), to one side of the main beam, the x-ray intensity was only 0.008 r per minute per microampere.

It is estimated that those who stood 100

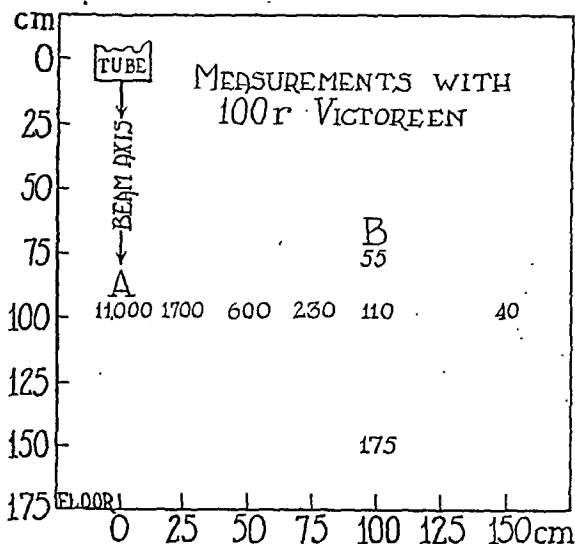


Chart II. Cathode ray intensity in r per minute per microampere-beam current versus position. With lucite cap, r at A = 0.28 and at B = 0.008.

cm. from the cathode port for 20 seconds received a skin dose of about 1,000 r on their faces and 2,000 r on their hands. The dosage on their feet would be greater except that this region was well protected by clothing. This estimate might be in error by a factor of two, due to the indeterminate beam current, and might be further in error due to the positions of the men, since the intensity increases very rapidly as one approaches the beam. The measurements also show that the effects will be limited entirely to the first 3 mm. below the surface and will be greatest in the first millimeter.

It seems logical to expect that the effect of a given tissue ionization dose will be the same for a 1,000-kv. cathode ray as for x-rays of similar wave length, since the ionization from x-rays is largely produced by secondary electrons with velocities approaching those of the electrons striking the target, and the damage to the tissues is also probably due to the effects of these electrons or the ions they produce. Thus the effect of cathode rays and of x-rays may be similar in regions receiving the same ionization dosage. It must be remembered, however, that the distribution of energy absorption in the body is very different for cathode rays from that for x-rays.

CLINICAL EFFECTS OF THE EXPOSURE

In spite of the short exposure, the burns were dramatic in appearance, and in three of the men had the unusual characteristic of showing three distinct phases. The first phase was superficial, was immediate or prompt in its appearance, and subsided in from five to seven days. It was followed by the secondary phase, with effects which were deeper, more widespread, and of longer duration. In some of the men these burns of the deeper tissues culminated in bleb formation and nearly complete loss of the epithelium. The third phase, appearing about four weeks after exposure, was characterized by much more extensive involvement and included a tertiary efflorescence which was widespread not only over new areas but also re-involving areas that had seemed to be healing from the secondary reaction.

During the exposure to cathode rays or immediately after leaving the room, the two fair-skinned men who wore no eye-glasses (*A* and *E*) noticed considerable irritation of the conjunctivae. At the moment, this was attributed to the large amount of ozone and the fact that film had been burning in the room. Two hours later, however, both men showed definite injection of the conjunctival vessels, with erythema of the face as well. Another man (*C*), who wore glasses, had a similar but less prompt and less intense effect. The conjunctival reaction subsided within three days.

By the next morning a superficial redness of the face and other exposed parts had developed which acted like the first extreme sunburn of the season. These effects were limited to the exposed areas, even a single layer of cotton cloth affording much protection. This first phase of the skin reaction was noted within four to thirty-six hours by all but one of the six men. This man (*F*) had a very dark olive skin; his first symptoms did not appear until eleven days after exposure, at the time the secondary phase became manifest in the others.

The first-phase reactions subsided in from five to seven days. The bright, deep red erythema faded to a dull red. Itching and a questionable tan appeared in the men with fair skin. The disappearance of the early reaction more or less merged into the secondary, deeper phase.

Approximately ten to twelve days after the exposure, the secondary phase was apparent in all of the group. It seemed to originate in the deeper tissues; the first evidence of its presence being noted as intense pain produced by shaving. This was not a superficial irritation, but gave the sensation of deeper pain, as when hairs are pulled out. One man (*A*) noticed the same deep tenderness in the nail beds of his hands, so that any use of the fingers, such as fastening a button, became an "almost impossible task." The tenderness was followed by a second increase in redness and edema of the involved parts and, in the more seriously affected cases, by blebs which contained clear fluid. The secondary phase lasted a varying length of time depending upon the severity of the burns. In the milder cases the tenderness disappeared after five to seven days, and shaving no longer caused pain. In three of the group this relief of tension occurred with crisis-like abruptness. In the more severe cases, reactions continued to appear in new areas which had been protected against the first phase by shirt, coat, trousers, or even shoes. One man (*A*) had pushed his dark adaptation red goggles up onto his forehead. These goggles were made of thin plastic material edged with leather binding. They completely protected his skin from the early phase of the burn, but directly below their lower margins the edema of the later secondary phase was marked (Color Plate I, 1-a to e).

Cytologic studies of the blood, made on the eleventh day after exposure, were normal in all the men.

Three weeks after the accident, three of the group (*D*, *E*, and *F*) had essentially recovered, and no subsequent reaction developed. *F*, a medical student, whose

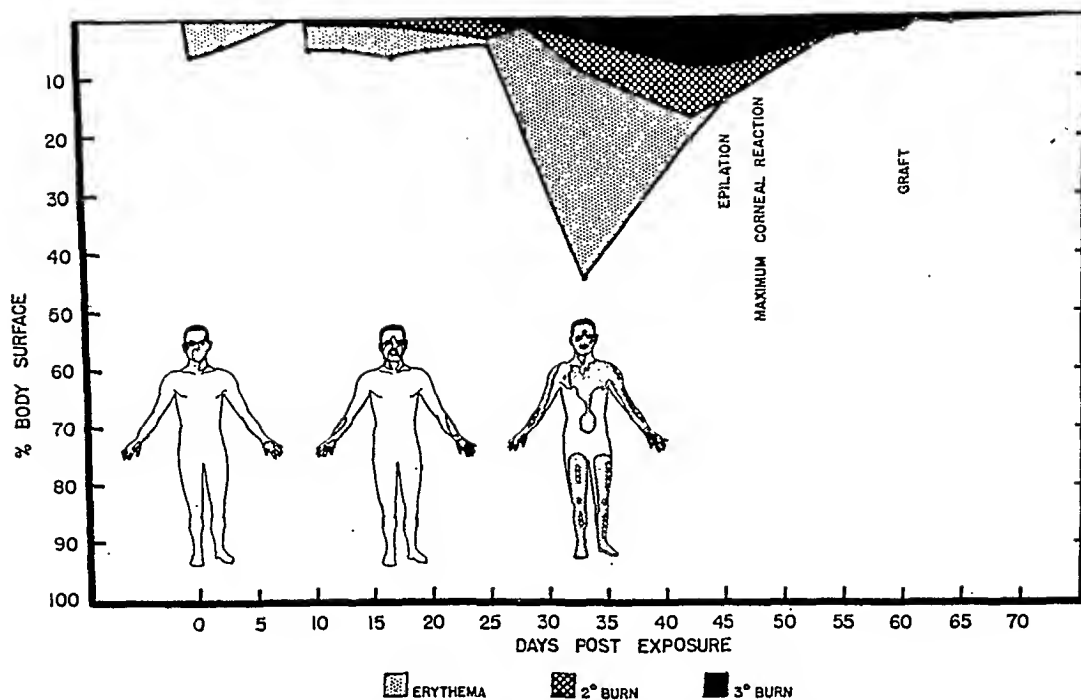


Fig. 3. Location, extent, and sequence of skin damage resulting from scattered cathode-ray exposure in Case A. The first phase, erythema only, started immediately after the exposure and had subsided before the appearance of the next phase. The second phase, first- and second-degree damage, started on the tenth day, and over it was superimposed the more extensive and deeper necrosis of the third phase.

peri-oral redness and edema had not appeared until the eleventh day and had subsided gradually, suffered the mildest reaction of the entire group. It seems highly probable that, although he was in the room a considerable length of time, two factors protected him. He stood farthest from the direct cathode beam and his complexion is extremely dark. *E*, a physician, had had marked edema of the eyelids and lips, erythema and deep tenderness of the face, and reddening of the skin over the chest. At the end of the second week, his first signs of improvement occurred within a half-hour's time, with a sudden release of the sensation of skin tension and deep pain. The entire reaction cleared up gradually during the third week. Although the immediate reaction in his eyes and the fair skin of his face had appeared to be the most severe of all, the secondary reaction was only moderate, and no tertiary phase was experienced. *D*, a medical student, having reached the peak of discomfort and disfigurement on the sixteenth day, made a rapid recovery. Some dis-

coloration of the face, slight tanning of the skin of the neck and upper chest, and a certain amount of inelasticity and thickening of the involved areas were the only effects in evidence at the end of three weeks.

In the remaining three men a tertiary phase of the cathode-ray reactions appeared approximately four weeks after exposure. Areas that had been protected against the first and second phases by one or two layers of cloth became involved, proving that this protection had been inadequate in preventing the later and deeper reaction (Fig. 3).

In addition, earlier lesions which had seemed to be in the final stage of healing from the secondary reaction became re-involved, going on to deeper destruction. This was maximal in *A*, in whom second-degree burns of the arms, legs, and chest developed, and who showed a further necrosis of areas on the hands that had appeared to be healing (Color Plates I-III, 2-a to i, 3-a to f). These hand lesions progressed to third-degree burns of such ex-

tent that eventual grafting of the left was necessary. In this man the sequence of events was essentially as follows:

Four weeks after exposure, although some areas of reaction were subsiding, others were becoming progressively more involved. The lower eyelids became more blistered, and new areas of redness had appeared below the hairline on the neck, extending down over the chest, the shoulders, the full extent of both arms, and the anterior surface of both thighs and shins. Five weeks after exposure, new lesions appeared on the toes of the left foot and the whole front of the abdomen; the chest had become darkly red, and the deeper portions of the derma were exposed over large areas of the arms and legs. These new lesions appeared at the same time healing was apparent in other earlier involved areas, as the skin of the face, which by the end of seven weeks showed only a deep remaining flush. Thin plastic glasses had protected the skin of the forehead and the eyebrows. It was at this time that the second eye involvement became manifest (see Ophthalmologic Observations, below).

Physicist B had practically recovered so far as his face was concerned at the end of three weeks (Color Plate III, 4-a to c). The dorsum of each hand, particularly the right, which had showed the erythema of the first phase and secondary re-involvement on the eleventh day, became much worse on the eighteenth day. The skin of both hands was desquamating by the twenty-first day, although there had been no blistering of the left hand. A band of normal skin on the fourth left finger, which had been protected by a wedding ring, stood out in contrast to the adjoining areas of edema and redness. By the beginning of the fifth week, as the hands were healing, an erythema appeared over the anterior chest, shoulders, and upper arms, areas which had not hitherto shown changes (Color Plate III, 4-d). Blisters and crusting developed over the shoulders.

In the case of *physician C*, the third patient to show the tertiary phase, an ery-

thema at the base of the neck and over the upper sternum appeared on the thirtieth day. At this time, the face and hands were nearly healed. Three days later a painful, tender erythema developed over the anterior surface of the knees; the discomfort persisted for a week with some desquamation and discoloration. At the end of two weeks the knee areas were again comfortable.

At the present time, six months after exposure, only one of the group, *A*, shows any noticeable evidence of injury.

The *treatment* employed was protection of the wounds by simple dressings and splinting, and to one patient (*A*) penicillin was administered. The erythema of the first phase seemingly required no treatment; none was carried out. The deeper disturbance of the second phase, on the other hand, was painful, and some relief was obtained by the general application of bland base ointments of either lanolin or petrolatum. When blebs appeared on the dorsum of the hands of three of the patients during the later (secondary) phase, gauze dressings with moderate pressure and splints were applied over the ointment. Effort was made to prevent bacterial contamination by keeping the bleb roofs intact. The bleb fluid in two of the men (*B* and *C*) remained clear and there was no clinical evidence of infection. Prompt healing proceeded beneath the blebs as evidence of the reaction elsewhere subsided.

In one patient who later developed full-thickness destruction of the skin (*A*), the blebs which started in the secondary phase became more extensive and ruptured with the introduction of the third phase. Because of the increasing depth of destruction and the lack of epidermal protection, this patient was hospitalized on the seventeenth day after exposure. The transudate from the wounds became purulent, and both a virulent staphylococcus and a non-pathogenic staphylococcus, typical of the normal skin flora, were obtained on culture. Penicillin was therefore administered intramuscularly, starting on the

twenty-first day, and was continued until three days before grafting, on the fifty-sixth day.

There was a striking absence of clinical evidence of infection in *A*, in spite of the presence on the wound surface of the virulent staphylococcus. The organism when first recovered was penicillin-sensitive, and it is therefore possible that the penicillin was helpful in preventing invasive sepsis of the surrounding derma and of the subcutaneous tissues. By two weeks after administration of penicillin had been instituted, however, the virulent staphylococcus was insensitive to the drug, in which state it persisted until healing of the hand wounds. In spite of the insensitivity, no sign of anything more than surface contamination occurred.

Summary of Ophthalmologic Observations

A transient redness of the conjunctivae and a smarting of the eyes occurred in three of the group. These symptoms came on within a few hours after the exposure and lasted from twenty-four to seventy-two hours. In one man lachrimation was noticed, but in none was any foreign body sensation or discharge from the eyes evident during this early period. The initial symptoms cleared up spontaneously, and, although all three men had some swelling of the lids about the tenth day, two of them had no further ocular symptoms. On the fourteenth day the third man (*A*) was examined with the slit-lamp and found to have 20 to 50 tiny vacuoles in the corneal epithelium of both eyes. The eyes were entirely white, however, and caused no subjective disturbance. The patient was not examined again until severe symptoms had developed. On the forty-second day after the exposure he complained of a marked foreign body sensation in his eyes, photophobia, and lachrimation. While both eyes were affected similarly, the symptoms began, and were continuously worse, in that eye (the left) which had been nearest the source of the cathode rays during the exposure. The essential objective findings consisted

of punctate and lacc-like opacities in the most superficial layers of the cornea without apparent involvement of the deeper layers of the cornea or of the other parts of the eye. The whole anterior surface of the cornea was stippled by what appeared to be punctate elevations of the epithelium. With fluorescein there was extensive punctate "take" of the dye. Despite the dry appearance of the corneas, there was a superfluity of tears. The corneal sensation was not reduced in either eye.² The ocular signs and symptoms reached a peak within a few days after their onset and continued essentially unchanged for two weeks. They then gradually subsided, and four weeks after the onset of the acute episode the eyes were considered approximately normal, although some punctate epithelial erosions persisted in the lower portions of the cornea for several months.

The corneal changes during the acute process were interpreted as consistent with the thesis that the essential lesion was a keratinization of the epithelium with secondary punctate erosions.

DISCUSSION

The exposures to cathode rays produced burns which were analogous to but different from sunburn, thermal burns, and roentgen-ray reactions. The primary reaction was like a very intense sunburn. It lasted about the same length of time but was not followed by the usual tanning. On the contrary, there ensued a secondary reaction characterized by edema limited to the skin, with bleb formation and a sensation of a deeper burn that involved the skin at the depth of the hair follicles. The less severe reaction, particularly on the face, subsided with surprising suddenness. At the same time three of the men who had been exposed showed new areas of involvement, appearing at varying intervals, in parts which had been protected by

² This is in contrast to the hypesthesia that is said to be characteristic of x-ray effects on the cornea. (See review by Rohrschneider: *Schädigungen des Sehorgans bei ther. Anwendung von X-ray u. Röntgenstrahlen*, Zentralbl. f. d. ges. Ophth. 23: 289, 1930.)

PLATE I

CASE A

1-a. 13th day: mid-secondary phase; second-degree burn of lips and eyelids; protection afforded by the leather margin of goggles apparent on forehead.

1-b. 21st day: late secondary phase, early tertiary phase. The tissue involvement is deeper and more widespread.

1-c. 28th day: tertiary phase. The protection initially afforded by the plastic material of the goggles is no longer effective; that of the leather remains effective. Epilation of eyebrows now apparent.

1-d. 42d day: tertiary phase. Healed except for the thin skin over the malar bones.

1-e. 161st day: residual atrophy, epilation, and telangiectasis of the thinner skin of the face.

2-a. 17th day: late secondary phase. The erythema persists. The deeper destruction of the tertiary phase has already begun.

2-b. 21st day: early tertiary phase. Erythema is again intensive and deeper destruction is spreading. The tertiary phase elsewhere in the body has not yet become apparent. Note absence of burn in fold between thumb and first finger.

2-c. 25th day: early tertiary phase. Erythema is less intense; deeper destruction slowly spreading. Staphylococcus albus recovered on culture. Patient on penicillin since twenty-first day.

2-d. 28th day: early tertiary phase. Second-degree destruction has reached its maximal extent but full-thickness destruction is not yet apparent.

2-e. 42d day: mid-period of tertiary phase. Maximal full-thickness skin destruction. Note gelatinous character of granulations and absence of subcutaneous edema. The contour of the knuckles is maintained and the extensor tendon of the middle finger shows through the thin layer of granulating fibrous tissue. The proliferation of epithelium is already under way. Such a picture is seldom seen following a thermal burn, where there is subcutaneous edema.



1-a



1-b



1-c



1-d



1-e



2-a



2-b



2-c



2-d



2-e

PLATE II

CASE A

2-f. 45th day: tertiary phase, early healing stage. The thin layer of slough has been dissolved by Dakin's solution. The thin layer of granulation tissue is vascular.

2-g. 54th day: tertiary phase. Wound is closing rapidly by epithelial proliferation from the periphery.

2-h. 60th day: tertiary phase, four days after grafting. Portions of the grafts are surviving, but healing is largely by peripheral proliferation.

2-i. 87th day: tertiary phase. Healing nearly complete. Note thinness of epilated skin on dorsum of both hands and all fingers of the left hand; also the separation of the nail from the nailbed of the index finger.

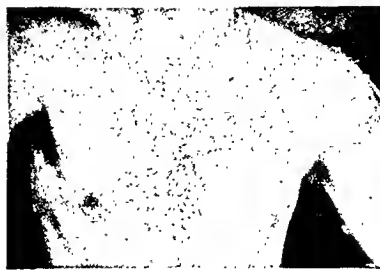
3-a. 28th day: initial tertiary phase, legs (1), chest (2), left arm (3). Erythema of portions of the body covered by clothing.

3-b. 33d day: middle tertiary phase. The erythema on the chest has spread and is more intense.

3-c. 42d day: tertiary phase at peak of destruction, upper legs (1), lower legs (2). The destruction extends well into the derma but is not full-thickness in any of the parts covered by clothing. Note absence of subcutaneous edema so characteristic of thermal burns. On the lower legs, note the protection afforded by the additional layer of underdrawers.



2-f



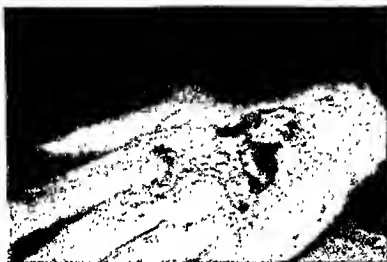
3-a, 2



2-g



3-a, 3



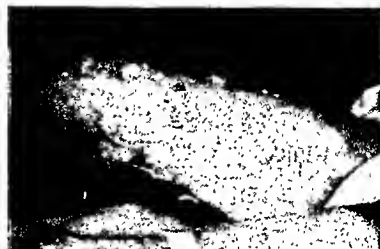
2-h



3-b



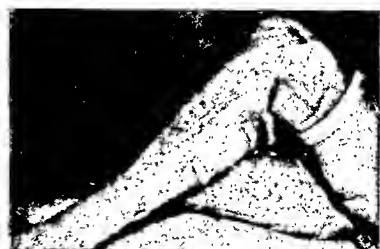
2-i



3-c, 1



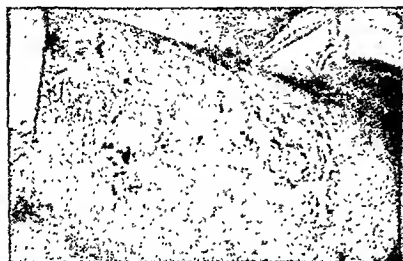
3-a, 1



3-c, 2



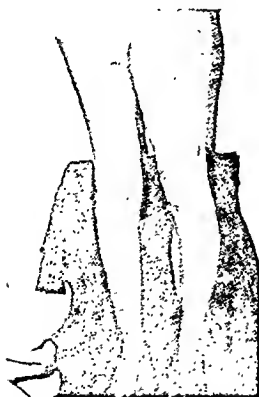
3-c, 3



3-d



3-e



3-f, 1



3-f, 2



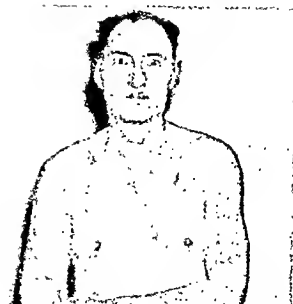
4-a



4-b



4-c



4-d

PLATE III

CASE A

3-c, 3. 42d day: tertiary phase at peak of destruction, left arm. Compare 3-a and 3-b, Plate II.

3-d. 45th day: tertiary phase at peak of destruction, left thigh. Epithelium is actively proliferating from islands deep in the derma.

3-e. 54th day: Late tertiary phase, left arm. All but the most deeply burned areas are healed.

3-f. 86th day: tertiary phase healed without residual pigmentation but with epilation, lower legs (1), arms (2).

CASE B

4-a. 3d day: primary phase. The erythema is apparent on the forehead, face, and neck. The ears are not involved. Eyeglasses and shirt with collar gave complete protection.

4-b. 10th day: secondary phase. Erythema or first-degree reaction. The erythema is most intense in the exposed areas, but the initial protection afforded by glasses and collar is partially absent in this phase. The ears, also, are now involved.

4-c. 17th day: secondary phase at a later stage. The reaction is more intense, with initial edema. Three days later blebs appeared around the lips, followed by desquamation. Glasses and collar have given only partial protection.

4-d. 35th day: tertiary phase. Desquamation is under way and the peak of the reaction has passed. Areas of the face involved in the primary and secondary phases are now pigmented. The upper arms and shoulders, where no reaction was visible during the first and second phases, show only slight tanning. The protection afforded by multilayers of cloth is clearly seen beneath the collar and the shoulder straps of the undershirt, and the rolled-up sleeves just above the elbows. The contrast between cathode-ray burns and x-ray burns, in which no protection would have been afforded by clothing, is evident.

the middle finger shows through a thin layer of granulating fibrous tissue. In this respect these burns differ from a thermal burn, in which the subcutaneous tissue would also be involved. The left hand is more severely injured than the right.

56th Day: The face, which suddenly began to improve a week ago, is practically free of redness and subjectively is comfortable. The skin is smooth and more normal looking. On the left shoulder is a scaling, healing second-degree burn about 1 inch in diameter. Some crusting areas remain on the left forearm and elbow. The right shoulder is also crusted. The lower legs show a little thickening of the skin, with crusting in several small areas. All the eyelashes on the left and the lower lashes on the right have come out. The right hand shows a long area over the thumb which is rapidly epithelializing. The left hand was grafted today.

80th Day: Has been back at work a week and is feeling well. A few small thin scars remain on the face. The skin around the eyes is extremely thin. The lashes, which had fallen out from both lids of both eyes, are beginning to grow on the upper lids. The hair on the exposed part of the wrists is still entirely gone. The right hand shows a few small crusts over the dorsum and the skin is thin. The thumbnail is almost off. On the left hand the index finger and thumb are losing their nails; a new one is growing on the finger.

87th Day: Healing of the hands is almost complete. The epilated skin on the dorsum of each hand and all the fingers of the left is thin, and the nail of the left index finger is necrotic.

96th Day: Is in excellent condition but looks older. The skin of the face is more wrinkled than formerly and has a mottled appearance. The eyebrows and upper eyelashes are growing but still look somewhat moth-eaten. The greatest loss of eyebrows occurred in the unprotected area adjacent to the leather edging of the goggles. (The question has been raised as to whether secondary rays were given off from the leather in this localized area.) Hairs, which had been heavy over the bridge of the nose, have disappeared entirely. The skin has a practically normal pink color except for mottling, and the usual pigmentation which has been lost in other burned areas is still in evidence on the forehead, which was covered by the dark glasses.

173d Day: Condition is about the same as it was three months ago. There are no lashes on the lower eyelids. The hair is beginning to regrow on the epilated areas of the extremities—over the deeper burns on the hands, and over the arms and legs. A band of heavy hair which was protected by the strap of a wrist-watch stands out in marked contrast to the epilation of the rest of the hand and forearm. The beard is intact. The skin, except for the protected area on the forehead, shows a striking loss of yellow pigment; it is pink in contrast to the more yellow unburned areas. There are, however, a good many areas with freckling which are of deeper

color than the normal skin that shows no freckling. There are a few telangiectases. In the more severely burned areas there is scarring with some fibrosis but there are no contractures. Though the skin of the left hand is rather tight, treatment has prevented any loss of motion.

Addendum Oct. 1, 1945. 304th Day: Since the last note there have been further changes. The telangiectases of the face have become somewhat more prominent, and the skin over the dorsum of the left hand and dorsum of left index and middle fingers by the 190th day had thinned out, with beginning necrosis. At first the skin changes in the hand were treated conservatively, but a 4-mm. area broke down and began to granulate. Since the tendon to the index finger was immediately beneath the open wound, secondary plastic procedures were decided upon. The affected skin was excised and a flap graft from the abdomen was placed over the tendon. The remainder of the wound was closed with a split-thickness graft. At operation it was noted that the vessels beneath the area of reaction were not thrombosed, as is usually seen in x-ray reaction. There was no evidence of necrosis or fibrosis beneath the skin. The earlier impression of the superficiality of the effect of the cathode rays was confirmed.

The grafts have taken successfully. Today, ten months after the accident (93 days after grafting), the hand is healed, and the general condition is the same as on the 173d day.

Ophthalmologic Progress Notes

(During the exposure, A, who wore no eyeglasses, stood so that his left side was nearer the source of the cathode rays. Within an hour he was aware of smarting of the skin of the face and of the eyes, likened to a sunburn sensation but unaccompanied by any foreign body sensation. Mild redness of the eyelids and conjunctivae was noticed within two hours after the exposure.)

1st Day: Mild conjunctival redness. On slit-lamp examination the corneas show no abnormality; lids show no abnormal folliculosis.

2d Day: Conjunctival redness has disappeared.

12th Day: Swelling of lids (and peri-oral region). Eyes white; corneas clear.

14th Day: Swelling of lids worse and accompanied by ulceration of skin surface. Conjunctivae are white. On slit-lamp examination the corneas show 20 to 50 tiny vacuoles within the epithelium, and the precorneal tear film contains somewhat more debris than normal. The patient has no symptoms referable to the eyes.

42d Day: Foreign body sensation noted for the first time, in the left eye only.

43d Day: Foreign body sensation, epiphora, photophobia, and considerable discomfort, but still in the left eye only. Gross examination shows ciliary injection and a nebulous superficial opacity in upper thirds of both corneas, more on the left,

accompanied by a stippled and dry appearance of the corresponding surface. The remaining portions of the corneas are normal, and the affected portions are demarcated from the unaffected portions by a horizontal line corresponding to the upper lid margin. The stippled areas show punctate staining with fluorescein. There are no marginal infiltrates. Smears of the conjunctival secretion show no eosinophils, inclusion bodies, or bacteria. Cultures taken from both eyes show coagulase-positive *Staphylococcus aureus* and attenuated hemolytic streptococcus. The patient was given penicillin ung. t.i.d. locally.

46th Day: Severe photophobia, foreign body sensation, and epiphora in both eyes. The eyelashes have fallen out completely from lower lids of both eyes and upper lid of left eye. Right eye shows marked ciliary injection. The surface of the upper half of the cornea has a dry appearance, with the stippling previously noted. No grossly visible opacity in this area. In the lower portions of the cornea there is a faint but definite opacity extending onto the lower cornea approximately 1 mm. from the limbus between 4 and 8 o'clock. The rest of the cornea has an irregular surface causing optical distortions but no opacity. Slit-lamp examination proved somewhat unsatisfactory because of extreme photophobia, but a faint haze of the epithelium can be made out in the central regions of the cornea; in the upper or more severely affected portions there appear to be punctate elevations of the surface. With the fluorescein stain there is no "take." The corneal sensation is normal. There is no edema of the corneal epithelium, and the corneal stroma is entirely clear; the posterior surface of the cornea shows no folds, and the anterior chamber shows no cells nor outstanding beam. The pupil is normal in size and reaction. *Left eye* shows the same signs as does the other eye, with a definite nebulous and trellis-like opacity in upper half of cornea and punctate "take" with fluorescein stain in lower half of cornea. The corneal sensation is normal.

49th Day: Examination essentially the same as previously noted except that each eye shows a generalized haze made up of punctate white flecks over the entire corneal surface; these flecks take the fluorescein stain. Penicillin ung. discontinued, and patient given 5 per cent sodium chloride ung. and 1 per cent atropine sulfate ung.

53d Day: Considerable subjective improvement. *Right eye* shows less ciliary injection and less pronounced stippling of cornea; numerous punctate flecks over entire corneal surface, which take the fluorescein stain. In the *left eye*, ciliary injection is unchanged; anterior surface of cornea shows a diffuse nebulous opacification with much punctate staining by fluorescein. With the slit-lamp this opacification appears to be confined to the epithelium and to be made up of granular white spots and ill-defined lines. There is no epithelial edema. The

corneal stroma is entirely clear, and the posterior surface shows no folds. The corneal sensation of both eyes is normal. Tearing measured by the Sjögren method is 10 mm./2 min. for both eyes.

57th Day: Examination shows marked improvement. *Right eye* is practically white. Corneal surface is smooth and lustrous. There is no stippling, but there is some irregularity of the surface on the left side of the cornea. *Left eye* shows mild ciliary injection. Stippling of corneal surface is still present but less marked. In the lower temporal quadrant of the left side, where the stippling was most evident, there is a superficial opacity measuring approximately 1.0×0.5 mm., extending upward from 6 o'clock. This opacity appears to be limited entirely to the epithelium. The rest of the cornea is normal.

60th Day: Further subjective improvement. In the *right eye* the only abnormality is some punctate areas that take the fluorescein stain. These are situated in the lower half of the cornea. *Left eye* shows continued mild ciliary injection. The cornea is lustrous except for the area previously described in the lower temporal quadrant. Here there is an elevated opacity, and from it there now appear to be thread-like lines in the epithelium, running transversely to lower nasal quadrant. There are considerable punctate staining of the entire surface with fluorescein and a mottled appearance to the specular reflex.

63d Day: *Right eye* entirely normal. No "take" with fluorescein. Corneal sensation normal. Lens clear. *Left eye* shows mild ciliary injection. Moderate punctate staining with fluorescein in lower third of cornea. In lower temporal quadrant there is the elevated gray area, now triangular in shape, measuring approximately 0.5 mm. on each side. This area does not, however, take the fluorescein stain. The corneal sensation is not diminished. The lens is clear.

69th Day: *Both eyes* white. The only abnormal residuum is the small elevated opacity in the lower temporal quadrant of the *left eye*.

76th Day: *Both eyes* entirely negative except for the absence of lashes of lower lids.

127th Day: The only ocular complaint is a slight purulent discharge in the morning. Examination of *both eyes* shows complete absence of lashes of lower lids, although the hair follicles can be easily made out; the posterior margins of the lids are unusually prominent, having a translucent lip rising approximately 0.5 mm. above the rest of the lid margin and with scalloped edges. The lower portions of the corneas show a few punctate gray flecks extending upward from the limbus 1-2 mm. between 4 and 8 o'clock. These flecks take the fluorescein stain. The rest of the corneas are normal.

189th Day: Eyes appear white and patient has no complaint other than slight discharge in the morning. Examination shows the same findings as previously noted except for some reduction in the number of punctate gray flecks on the surface of the

lower portions of the cornea. These corneal changes can be seen only with the slit-lamp. On gross examination the eyes would be considered normal. Vision is normal.

Addendum Oct. 1, 1945. 304th Day: Patient's only ocular complaint continues to be slight discharge in the morning. There is still practically complete absence of lashes of lower lids, but hair follicles are present; upper lids show only slight reduction in lashes. A noteworthy change from the status at the previous examination is the dilatation of the vessels on the conjunctival surface of both lower lids. This is especially conspicuous on the left side, where the vessels form gross telangiectases and in one area extend over onto the anterior surface of the lid. The bulbar conjunctiva and cornea of each eye appear normal in every way.

B. On the morning of the day the accident occurred, this 40-year-old physicist, with medium-fair complexion and wearing eyeglasses, had entered the room twice while working on the machine. He was wearing no coat and his shirt sleeves were rolled above the elbow during the time he was exposed. Inasmuch as there is no magnetic focusing device on the machine, it was necessary either to burn holes in film or, to determine where the focal spot was located on the target in a quicker manner, to look at it through a mirror. Being uncertain in which direction the focal spot was wandering, the physicist took a brief look directly at the window, noting that the focal spot was considerably to the side of the target. After adjusting the machine, he again entered the room to observe the fluorescent target, receiving a second exposure. He estimated that during each exposure he stood not closer than 4 or 5 feet to the center of the beam and was not in the room longer than 10 seconds. He observed nothing unusual physically but smelled a slight odor which he thought to be due to ozone in the room. He did not enter the room in the afternoon, when the other five men were exposed.

He noticed no abnormal sensations until the next morning, when shaving, he was aware of his skin without feeling any true pain. Two hours later, when he reached the hospital, it was apparent that his face and the exposed surfaces of both arms and forearms were reddened. There was questionable slight injection of the conjunctival vessels but no abnormal sensation. By the end of the day some redness was noticeable over the shoulders and that portion of the chest which had not been protected by his undershirt. This regressed fairly rapidly and did not cause any subjective symptoms. Four days after the exposure slight irritation of the eyes appeared about the outer canthi; this cleared up in five days. During this period the color of the skin faded, but not constantly, since the redness recurred intermittently (Color Plate III, 4-a to d).

On the eighth day after the exposure the areas about the nose and upper lip became sore and

edematous, and "cold sores" appeared at the corners of the mouth. On the tenth day, the nose was red and swollen, as was the anterior portion of the chin. Shaving over this latter area was painful, although the sides of the face remained nearly normal. The lips became sore, cracked, and blistered. The reaction continued acute until the fourteenth day, when there was a sudden decrease in the amount of pain and edema. The face continued to improve. On the eleventh day, the backs of the hands became red and tender.

Progress Notes

13th Day: The face shows a sharply demarcated area of redness beginning below the glasses and extending sideways to the mid-cheeks and downward to the edge of the chin. The man is bald over the front of the head but this area was not involved. He wears a short mustache, which is not affected; his upper lip is sensitive but less so than a week ago. The lips are healing but slight cracks are still present. The mucous membrane inside the mouth is normal; the tongue is normal. The nose and lower jaw appear a little bumpy, uneven in texture. The backs of the hands show increasing erythema.

17th Day: The face shows marked improvement. Both hands show great redness but no blistering, with sharply delineated lines where the skin was protected from superficial exposure, as between the fingers. Chlorophyll ointment has been used on the left hand, covered with a white cotton glove. The area on the left fourth finger protected by a wedding ring shows no redness nor edema. There is superficial desquamation over the dorsum of the right hand with good dermis beneath it. This hand is put up in splint and bandage today.

27th Day: As the lesions on the hands were clearing, erythema developed on areas not previously involved, on the shoulders and on the upper and anterior portions of the chest.

32d Day: Face looks entirely normal; hands are slightly red but otherwise normal.

45th Day: Entirely recovered. Face remains normal. The skin on the hands is slightly redder and softer than usual but is otherwise normal. The skin over the slightly involved areas on the shoulders is peeling.

182d Day: As far as can be determined, except for questionable atrophy of the skin over the backs of the hands, there are no late effects. Where epilation occurred, hair is growing.

Addendum Oct. 1, 1945. 304th Day: There have been no particular changes in general condition. It was noted through the summer that no tanning followed exposure to sunlight over the dorsum of the right hand and forearm.

C. This 37-year-old resident in radiology, wearing the usual white uniform, is dark-skinned and wears eyeglasses. He was in the room about 5 minutes and during the exposure stood about 6 feet from the target, bending down at one point for 5 to

6 seconds. His face became very red, shiny, and edematous almost at once. Later in the day he noticed some burning and stinging of the face, particularly about the eyes, and by evening it felt hot. On the second day his eyes were inflamed and burning. They cleared rapidly, returning to normal by the fourth or fifth day. The acute redness of the face faded after about four days. At this time diffuse redness appeared over the chest; it had disappeared twelve days after the exposure. As the superficial redness left his face, a deeper reaction developed and progressed. This was characterized by marked tenderness, so that shaving was painful. The lips became cracked at the edges and showed a line of herpes, ulcerating where the dry and the moist edges joined.

Progress Notes

13th Day: The most marked lesion is about the mouth, where the patient shaves. The edges of the lips are cracked, and opening the mouth causes pain. The lower lip is denuded all along its edge; both lips are swollen and hot. Hands show increasing erythema on the backs.

17th Day: Face still shows areas which ooze. The hands show dorsal desquamation, redness, and edema. After being dressed with chlorophyll ointment they were bandaged and were definitely more comfortable when immobilized.

19th Day: Face improving; redness around peri-oral area remains. Hands are kept bandaged. A little clear fluid oozes from the left hand.

27th Day: Face practically normal. Right hand out of bandage; new skin covers the desquamated area.

30th Day: A new area of erythema has appeared at the root of the neck.

32d Day: Face looks normal. The skin has peeled from the hands, leaving a slightly red new dermis. The recently involved area on the neck is now sharply delineated, dark red in color. Areas of erythema have appeared also over both knees.

33d Day: Skin over both knees is red, painful, and tender to touch.

45th Day: A circular area about 7.5 cm. in diameter is present over each knee. After the appearance of these lesions 2 weeks ago, they became progressively worse subjectively and objectively. They are now subsiding but still show swelling, discoloration, and scaling. They are no longer tender.

57th Day: Seems perfectly well. Skin has regained its normal color. Although no epilation occurred on the face, it was evident in other areas and is still apparent on the dorsum of each hand, over an area on the right forearm and a small area on each knee.

182d Day: The skin over the backs of the hands is soft, and hair is growing in the areas of most severe injury. In this same area a very faint freckle-like pigmentation is noticeable. Otherwise there are no visible late effects.

Addendum, Oct. 1, 1945. 304th Day: There has been no change in the general condition, except that there has been no tanning on exposure to sunlight over the right first and second and the left first, second, and third knuckles.

D. This 24-year-old blond medical student, with eyeglasses, was wearing an Army uniform but no blouse. The total time he spent in the room did not exceed 8 minutes, and during most of it he stood 5 or 6 feet away from the direct beam. At one time, for about 30 seconds, he bent down so that his head was about 4 feet above the floor and 3 feet from the direct beam, in order to observe more closely the "hot aluminum plate" and a piece of fluorescent material on the floor directly beneath the tube.

He experienced no ill effects from the exposure until the following evening. After running several miles for exercise, he then observed some reddening of the cheeks, which he attributed to wind burn. Twelve hours later, this initial change instead of subsiding had expanded into a slight but definite diffuse "blush" over the entire face anteriorly, avoiding, however, the sides of the cheeks, temples, and ears. A subjective feeling of warmth over the same area, without tenderness, accompanied the reddening.

In the next 4 days, as the color became more intense, the regions of most extensive injury were seen to be those around the bridge of the nose and lateral to the nares and around the lips. For a time these areas, unlike sunburn, had a "blotchy" appearance. The skin increased in warmth and became sensitive. On the eighth day after exposure, the lips were swollen slightly, dry, roughened, and inclined to chap readily. The tendency to fissures was controlled for 3 days by a proprietary "chapstick."

About 4 days after exposure, a slight but indisputable erythema appeared over the anterior portions of the shins, thighs, upper chest, and arms. The hands and areas covered by collar and shorts were normal in appearance. The patient's eyeglasses with plastic frames seemed to have afforded complete protection.

The warmth, swelling, and redness, particularly about the mouth, slowly increased. On the tenth day, a slight superficial desquamation and tendency to fissure formation when the skin was wrinkled was observed over an area on the nose 1.25 cm. in diameter. This cleared up in 3 or 4 days. On the eleventh day, a similar area appeared between the lower lip and chin, underwent identical changes, and healed in about 12 hours, only to be followed by the development of more severe cracks and crust formation at the corners of the mouth. These healed in about a week.

The entire reaction probably attained its maximum in disfigurement and discomfort on the sixteenth day following exposure. The lips were sore, swollen, and burning, especially at the mucocutaneous junction. The mouth could not be opened widely;

citrus fruits, acid- or vinegar-containing food could not be taken without sharp pain. Exposure to cold (15° F.) for several hours seemed to aggravate the tenderness and erythema. Alcohol produced a transient, but considerable increase in color. Smiling, laughing, or even talking with expression was most uncomfortable from the fourteenth to the eighteenth day after exposure. Bland ointments afforded relief. At no time was the pain sufficient to interfere with sleep or pleasure.

On the eighteenth day after exposure, subsidence of the lip swelling was beginning. The skin of the forehead, nose, and chin still felt somewhat stiff and inelastic, was slightly thickened, burned when stretched, and itched at times. The color had darkened from its fiery redness, and those areas more lightly involved showed a slight tan. The most seriously affected areas resembled a fresh sunburn; they were still warm to touch, blanching on pressure. They were no longer tender or painful.

The patient had no tertiary reaction and appeared and felt perfectly normal 2 months after the accident. At the time of writing, 6 months after it, no late effects are apparent.

Addendum Oct. 1, 1945. 304th Day: No further changes noted. No peculiarities regarding exposure to sunlight throughout the summer recognized.

E. This 33-year-old physician, having fair skin and wearing no eyeglasses, estimated that he was in the room about 2 minutes, standing 4 to 5 feet away from the direct beam. He glanced at the fluorescent window and almost immediately noticed irritation of his eyes, which at the time he attributed to ozone and the film which had been burned in the room. He was standing in the doorway of the room when the second exposure was made.

Within 5 minutes the conjunctival vessels of both eyes were seen to be markedly injected. An hour later the face was red and felt warm. Within 4 hours there was a rather marked erythema of the face and of the right upper extremity from the tips of the fingers to the shoulder, except for an area covered by a rolled shirt sleeve. The physician had been wearing a white coat at the time of the exposure and the anterior chest which was not protected by the coat showed some erythema. The peak of the reaction in the conjunctivae was reached in 20 hours and subsided thereafter. From the fifth to the tenth day the erythema gradually decreased to an atypical tan. No additional areas of redness appeared, although there was some tingling felt along the anterior and lateral margins of the right lower leg. The only sensations noted other than this were the feeling of warmth of the skin and some itching. The reddened areas were treated with lanolin.

On the ninth day, after the physician had been doing some painting at home, his face became extremely uncomfortable; over the anterior portion it appeared a livid red, and definite edema was noticed.

It grew worse during the next 3 days, becoming very tender—particularly painful on shaving—with marked swelling of the eyelids.

Progress Notes

13th Day: Superficial skin can be rubbed off the lower jaw. Herpes-like lesions which had appeared along the upper lip, at the junction of the mucous membrane, are now healed. The entire face is still red and slightly blotchy, more especially the lower face. The eyelids are still edematous, but improving. The chest is slightly red. The arm is normal; the demarcating line which indicated the end of the rolled-up sleeve is no longer visible. Last night the deep tenderness suddenly ameliorated as the edema decreased.

17th Day: Approaching normal.

20th Day: Face appears entirely normal.

182d Day: Has remained normal. No unusual effects have followed exposure to cold or to sunlight. No epilation was noted at any time.

Addendum Oct. 1, 1945. 304th Day: No further changes noted. No peculiarities regarding exposure to sunlight throughout the summer recognized.

F. A 22-year-old medical student, with dark olive complexion and wearing glasses, estimated that he was in the room for 10 minutes. He believes that he stood about 8 feet from the target most of the time and was in an upright position except for a brief look at the fluorescent window. He was wearing his Army uniform without the blouse. He experienced no immediate reaction of any sort.

On the ninth day after the exposure he thought there was some questionable erythema on one leg, but it had entirely disappeared by night. On the eleventh day, after shaving, he noticed that his face was very sore and quite red generally. During that day the face felt as if it were chapped, with a sensation of dryness and stiffness, and it was difficult to open the mouth widely. There were swelling and scaling of the lips, with a somewhat herpes-like lesion present.

All tenderness and pain subsided abruptly on the thirteenth day. The upper peri-oral redness and edema continued to subside up to the eighteenth day, when the appearance was normal. There were no subsequent ill effects.

Addendum Oct. 1, 1945. 304th Day: No further changes noted. No peculiarities regarding exposure to sunlight throughout the summer recognized.

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simple increased visibility of the bronchial shadow. It is possible that this stage is non-specific and is merely an exudative response, either inflammatory or allergic, to the infected material bathing the mucosa (Fig. 1).² In any case, the rapid clearing of such a prominent bronchial shadow suggests either a non-specific process or a very minimal tuberculosis. At this stage there may be complete reversibility of the lung shadows to normal or the resolution may

bronchial wall, with resultant bronchial thickening. At this stage the roentgen visibility of the bronchial shadows is further increased. The walls of the bronchi are seen as two closely related, dense, parallel lines, separated by a central shadow caused by the lumen. This can frequently be recognized even when disease in the contiguous parenchyma tends to obscure the shadows (Fig. 2). We have been impressed with the value of tomography



Fig. 3. Established disease of the draining bronchus from a tuberculous cavity. The regular bronchus may be seen extending from the hilum toward the base of the cavity. The shadow between the cavity and the hilum is due to the bronchial disease and peribronchial reaction.

be so great as to leave no detectable residual roentgen markings.

When the bronchial disease has progressed just beyond the non-specific or incipient stage, it is associated with submucous tubercles and, later, with submucous extension and infiltration. The lesion may extend to the surface of the lumen, causing an elevation of the mucosa, or it may permeate into other parts of the

in verifying the impression of bronchial disease. It is the opinion of the majority of pathologists that the dependent portion of the trachea, over which most of the infected material passes, is the site of greatest involvement (10). Tomography of a draining bronchus with a thickened dependent wall (Fig. 3) would seem to indicate that the same is true for bronchi.

When the infection extends through the mucosa, ulceration results. Further growth above the surface causes irregular granulomatous lesions (10). These ulcers

²The photographs used for this paper were done by the chief staff photographer, David L. Buckler. Contrast points have been used for Figure 1, as these show the early lesion a to better advantage.

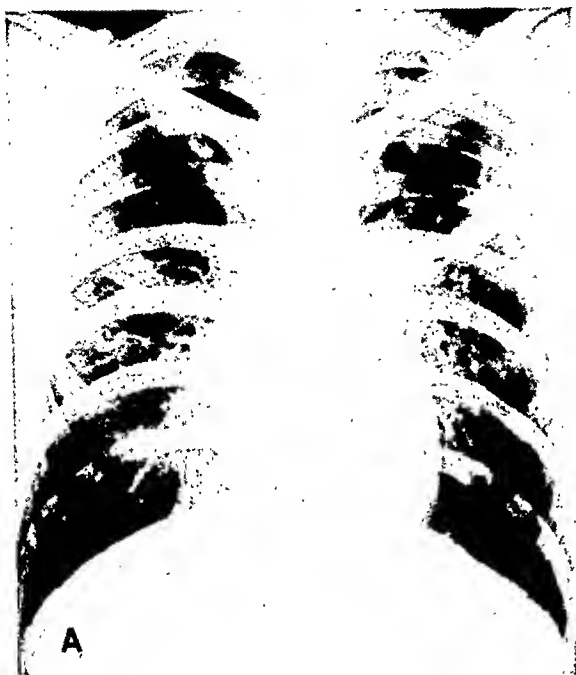
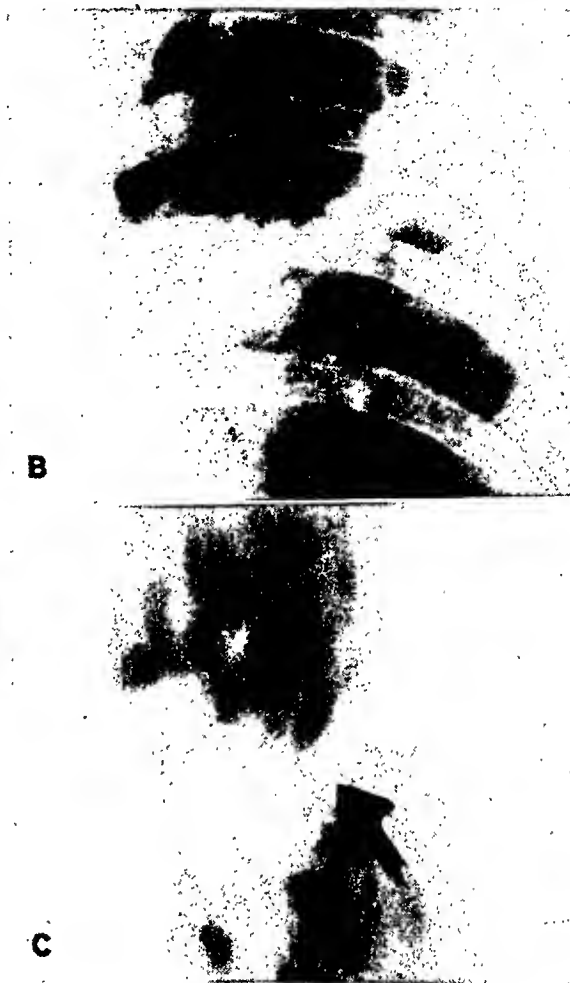


Fig. 5. A. The shadow between the left hilum and the cavity in the left upper lobe represents the draining bronchial shadow with peribronchial reaction. Bronchoscopy revealed swelling and bleeding of the left main bronchus, with a suggestion of early ulceration just below the left upper lobe branch.

B. Detail photograph of the area being studied.

C. Tomograph through the bronchus draining the cavity, taken very shortly after 5, A. The bronchial shadow is widened. Its wall is thickened and edematous. Its lumen is narrowed and irregular.



granulomas represent a very active stage of the disease, during which there is continued extension along the bronchial wall (5). It is to be expected that all layers of the bronchus will now be affected. The bronchial wall shadow will be denser, more irregular, and wider in diameter. Its lumen will be narrowed and irregular. A peribronchial reaction will be present in the contiguous pulmonary areas. This may occasionally be seen as a soft exudative shadow which lies between the cavity and the hilum (Fig. 4). While in most instances the bronchial shadows will be identifiable, nevertheless, even in the absence of exact identification, the shadow between the cavity and the hilum must be attributed to the regional bronchial and peribronchial pathology. While the bronchoscopist may now be limited to the visualization of one end of the lumen of such

a lesion, the radiologist may demonstrate it in its entirety.

If the ulcerogranuloma completely fills the bronchus, the occlusion may cause peripheral atelectasis. Myerson (5) believes that when a suppurative focus drains *via* the bronchus, the washings tend to prevent complete occlusion. With continued advance of the disease, the surface of the ulcerogranulomatous lesions may degenerate. Myerson calls this stage "ulcerogranuloma with caseation," and states that it has also been called caseous endobronchitis (Loeschke) and caseous necrotic bronchitis (Ornstein and Epstein). It is expected that the bronchial and peribronchial shadows at this stage will be even more pronounced (Fig. 5). Several bronchi may drain a larger area of involvement, as may be demonstrated on the roentgenogram (Figs. 8, 9, 10). Resolu-

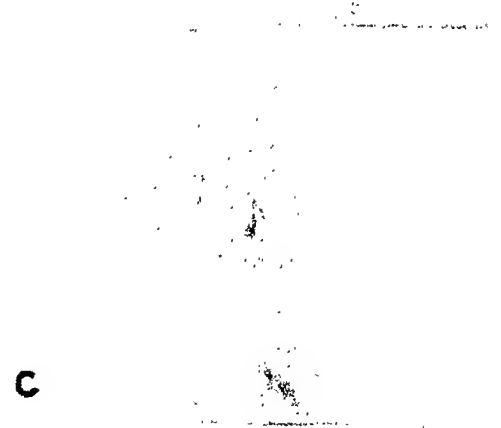
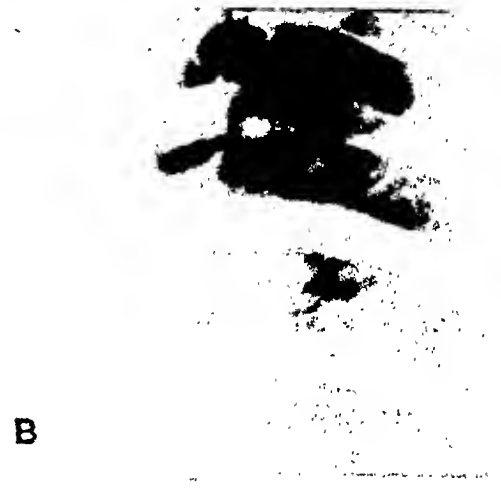




Fig. 8. A. Draining bronchi from multiple tuberculous cavities in the left upper lobe lie between the cavities and the hilum. B. Detail photograph of the area.

tion of the tuberculous bronchitis, with healing of the cavity being drained, is almost invariably associated with some fibrous changes. The clearing of the extensive disease is reflected by a reversal of the roentgen findings, with diminished visibility of the bronchial shadow and a return of its wall thickness and lumen outline toward normal (Figs. 5, 6, 7). When the disease has been extensive, however, the fibrous residua may be represented as well demarcated linear fibrotic strands which extend outward from the hilum into the lung fields (Fig. 7). These are frequently misinterpreted as being due to previous parenchymal rather than bronchial disease.

If the cavitation or pulmonary suppurative disease becomes worse, the draining bronchi will reflect this by advance of the chronic changes in their walls. The productive changes in the wall produce a rigidity, straightening, and shortening. The condition is associated with varying degrees of stenosis, caused by scarring and

fibrous changes. The partial or complete occlusion of the bronchial lumen may contribute to bronchiectatic changes in the peripheral arborization, especially since the walls are already diseased. Stiffening of the bronchial walls may keep them rigidly patent, as with arteriosclerotic arteries (Coryllos) (Fig 10). Occlusion of the bronchus, rigid patency of the bronchus, or ball-valve mechanisms would be reflected in the status of the cavity or the peripheral lung.

The presence of linear bronchial markings which extend into the lung field from a hilum should lead to the suspicion that a hidden cavity is being drained. In the presence of such shadows, a careful search, including tomographic study, should be made before the presence of a cavity is excluded (Fig. 11). As a corollary to this, in the presence of a radiolucent area of doubtful nature, the finding of a draining bronchus might indicate that the radiolucency was due to a cavity.

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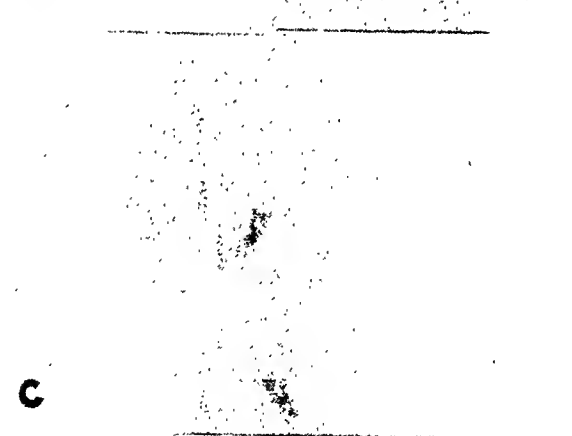
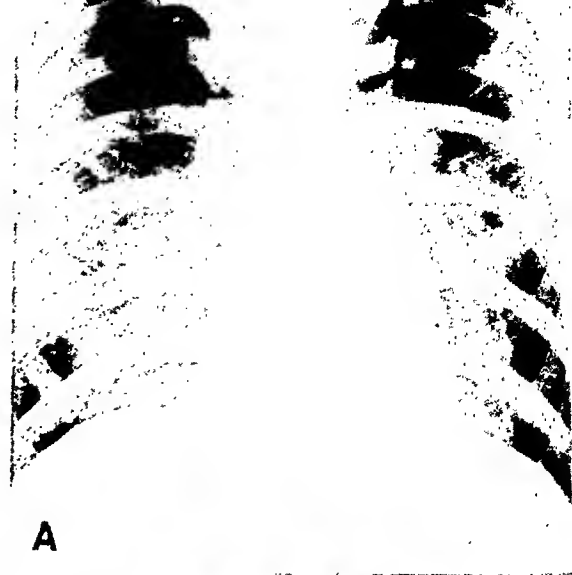


Fig. 6. Same case as Figure 5, approximately seven weeks later, showing some resolution.

A. The cavity is no longer seen. The shadow between the hilum and the primary lesion has begun to resolve.

B. Detail photograph of the area being studied.

C. Tomographic study of the bronchus, showing it to be still diseased. Its walls, although still involved, are thinner than on the first study. The bronchial lumen is wider and less irregular. (This film was difficult to reproduce successfully.)

Fig. 7. Same case as Figures 5 and 6, approximately seven months later.

A and B. The site of the original cavity is indicated by a few hardly distinguishable markings. The bronchial shadows are still visible, but much less marked than before.

C. Tomograph showing the bronchus to be thin-walled, and its lumen more regular and patent. There is a slight residual thickening of the walls; otherwise there has been a remarkable resolution of the tuberculous process as compared to the original status. Compare this with Figure 5, C, taken through the same level.



Fig. 8. A. Draining bronchi from multiple tuberculous cavities in the left upper lobe lie between the cavities and the hilum. B. Detail photograph of the area.

tion of the tuberculous bronchitis, with healing of the cavity being drained, is almost invariably associated with some fibrous changes. The clearing of the extensive disease is reflected by a reversal of the roentgen findings, with diminished visibility of the bronchial shadow and a return of its wall thickness and lumen outline toward normal (Figs. 5, 6, 7). When the disease has been extensive, however, the fibrous residua may be represented as well demarcated linear fibrotic strands which extend outward from the hilum into the lung fields (Fig. 7). These are frequently misinterpreted as being due to previous parenchymal rather than bronchial disease.

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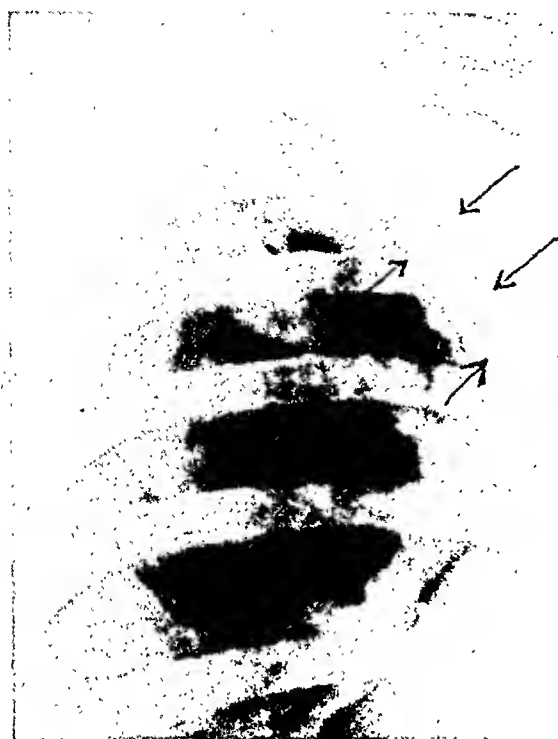


Fig. 9. Large area of involvement in the right apex and retroclavicular area, drained by several diseased bronchi.

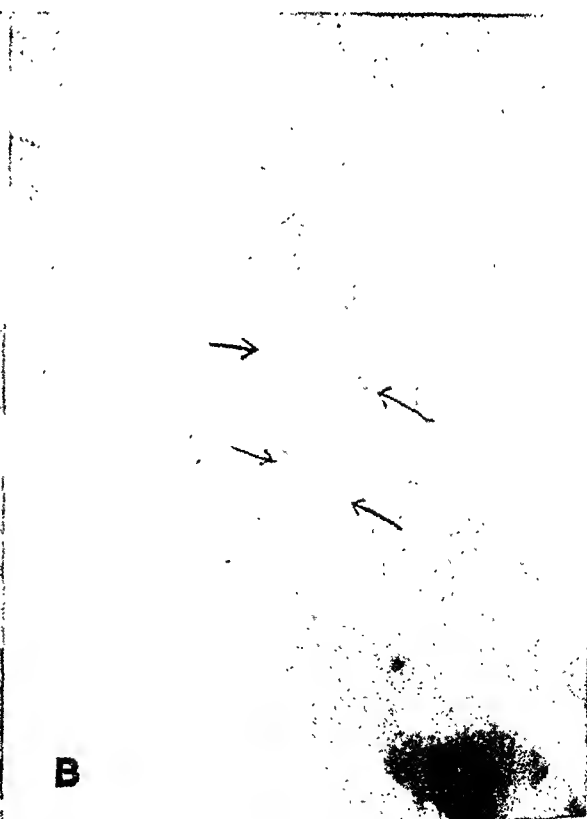
entation of the uncomplicated and more easily recognized bronchial lesions. With close scrutiny, however, the radiologist will be able to pick out the diseased bronchi even in the presence of extensive surrounding pulmonary disease. Tomographic studies have proved to be of great value. In the absence of equipment for that procedure, Bucky studies are informative.

A summary of some of the clinical aspects of bronchial tuberculosis may be of value to the reader. A short verbatim excerpt from the excellent report by Riggins (9) is therefore presented.

"A tentative diagnosis of bronchial tuberculosis is warranted if any of the following symptoms or findings are present: positive sputum without demonstrable cavity; unilateral wheezing (is never asthmatic); lobar atelectasis or obstructive emphysema; cavities with fluid level; rapid and undue enlargement of a thin-walled cavity surrounded by relatively healthy lung, (positive pressure cavity), unexplained inability to close cavities with pneumothorax in the absence of extensive surrounding



A



B

Fig. 10. A. Several bronchi may be identified as draining the diseased area in the left apex. Pneumothorax has not resulted in collapse of the cavity. B. The same cavity following thoracoplasty. It is compressed but not collapsed. The rigid bronchi are still plainly demonstrated.

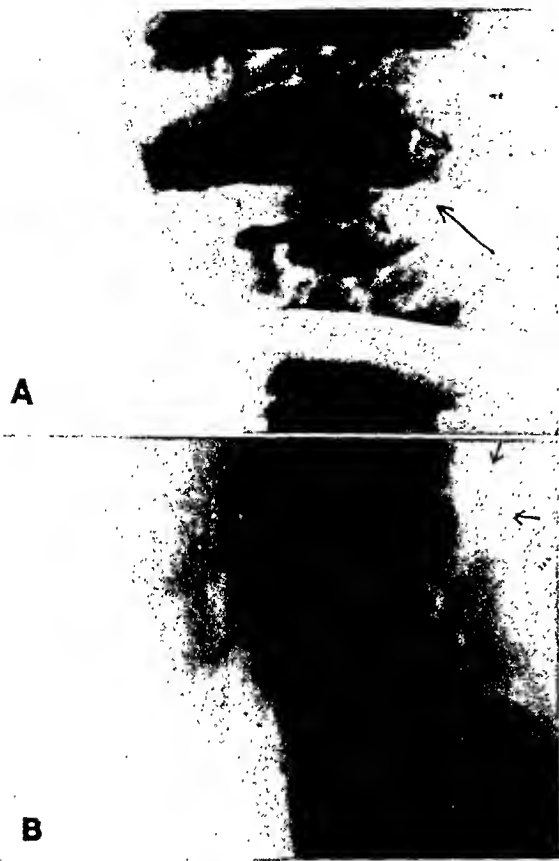


Fig. 11. No cavity can be seen on the routine study. The presence of visible bronchial markings suggests that a hidden cavity is being drained. B. Tomography confirms the presence of a draining cavity. The bronchus may be seen extending from the cavity toward the hilum. This could be seen better with transillumination of the film than the reproduction demonstrates.

caseation or adhesions; pendulum sway of the mediastinum in non-pneumothorax cases with bronchial stenosis and obstructive emphysema; undue dyspnea; harrassing or stridulous cough; wide variation in the amount of sputum; occasionally or persistently foul sputum; periodic febrile attacks unassociated with obvious cause (retention of secretions); recurring attacks of bronchopneumonia with negative sputum; and the development of bronchiectasis or acute putrid lung abscesses in patients with pulmonary tuberculosis."

SUMMARY

1. The lung shadows between a tuberculous cavity and the hilum contain the regional bronchi and the peribronchial vascular and lymphatic channels which drain the area of parenchymal involvement toward the lung root.

2. Heretofore the diagnosis of disease of the draining bronchi from tuberculous

cavities was based upon clinical evidence, bronchoscopic findings, and circumstantial roentgen signs.

3. The roentgen shadows of the draining bronchi have a characteristic appearance, which permits an opinion as to their status.

4. The roentgen characteristics of the draining bronchi from tuberculous cavities are enumerated, with illustrated examples.

5. All of the cases presented were of proved tuberculous etiology. It is to be inferred, however, that the draining bronchi from non-tuberculous lesions may also be demonstrated.

ACKNOWLEDGMENT: My interest in this subject derives from an article on the pathology of tracheo-bronchial tuberculosis which was written by Dr. Gertrude Silverman (10) at the suggestion of Dr. H. McLeod Riggins. Dr. Riggins' keen clinical emphasis prompted me to independent roentgen observations. I wish to thank Dr. Richard H. Bennett for his interest and permission to use material from his medical service.

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A Study of the Ureters in Bladder Neck Obstructions¹

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SOON AFTER THE introduction of intravenous urography, it was employed routinely in all cases of bladder neck obstruction on the service of one of the writers (H. L. K.). Early in its use we were impressed by the frequency with which hydronephrosis and hydro-ureter

reach an erroneous conclusion, thus overlooking a serious renal lesion.

As time has gone on and more and more patients have become familiar with the possibility of being relieved of obstruction by transurethral resection instead of open operation, with its lower mortality and



Fig. 1. Tortuous left ureter.

were found, and often in cases in which dilatation was not suspected. The routine use of intravenous urography revealed, also, other types of renal disease that was not suspected and hence would have been overlooked. We refer to malignant tumors and solitary cysts of the kidney. In patients with bladder neck obstruction who give a history of gross hematuria, one is likely to ascribe the bleeding to the obstruction, and hence

morbidity, they now seek relief early rather than late in the course of their illness. Consequently, patients with large hydronephroses and hydro-ureters, large diverticula, and bladder stones are fewer in number.

As a result of our observations of the frequency with which these changes were found, we became interested in a study of the course of the ureter. This paper is in the nature of a preliminary report of this

¹ From the Presbyterian Hospital of Chicago. Read before the Joint Meeting of the American Roentgen Ray Society and the Radiological Society of North America, Chicago, Ill., Sept. 24-29, 1944.

² President of the American Medical Association.



Figs. 2 and 3. Right-angle turn of ureter emptying high in the bladder.



Fig. 4. Looping of ureter in pelvis before entering bladder.
Fig 5. Lateral displacement of right lower ureter.

study, being based upon a review of 120 films selected at random from the roentgen-ray department of the Presbyterian Hospital.

An interesting observation to which we should like to refer is the fact that in a relatively large number of patients the lower part of the ureter was not visualized. The reason for this we do not know. Because of this lack of visualization of the lower part of the ureter, it was necessary to review a great many films in order to obtain 120 in which visualization was present.

For purposes of presentation the cases were divided into two groups: those in which the course of the ureter was normal, and those in which there was some deviation from the normal course.

1. *Normal Course:* In 53 cases, or 44.16 per cent, the course of the ureter was normal. A study of the records disclosed that 48 of this group, or 90.56 per cent, had benign obstruction, and 5, or 9.43 per cent, had carcinoma. In other words, in nearly one-half of our cases, the course of the ureter was normal.

2. *Deviation from Normal:* This group forms the basis of this preliminary report.

It includes 67 cases or 55.82 per cent of the total. Of this number, 60, or 89.55 per cent, had benign obstruction, and 7, or 10.44 per cent, had carcinoma.

A review of this group disclosed the following abnormalities in the course of the pelvic portion of the ureter:

Right-angle turn of ureter.....	25
Right-angle turn of ureter, high.....	4
Lateral displacement of ureter	
Marked	7
Slight	2
Looping of ureter.....	12
High entrance of ureter into bladder..	4
Low entrance of ureter into bladder..	2
Entrance of ureter at mid-line.....	2
Dilatation of ureter	
Marked	13
Slight	11
Tortuous ureter.....	3
Hydronephrosis	6
Normal course with dilatation.....	8
Normal entrance of ureter with lateral displacement.....	4

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Diagnosis of Pes Planus by X-Ray¹

CAPT. WILLIAM L. BONNET, M.C., A.U.S., and CAPT. D. R. BAKER, M.C., A.U.S.

BECAUSE of numerous complaints relative to the feet, among the Armed Forces, it was decided at this Station to conduct a survey of foot cases. Letters from officers stationed overseas led us to the conclusion that many men were being shipped out with foot conditions which caused them to become incapacitated, either partially or wholly, thus imposing a burden upon their organization and also sharply reducing their own personal morale. Men with

apparently insignificant foot disorders to manifest symptoms, ranging from those of a minor nature to incapacitation.

According to Ilfeld (1), approximately 50 per cent of those appearing before the CDD Board at the Station Hospital, Camp Callan, California, came because of orthopedic complaints, and of these one-third were foot complaints. Morton (2) has estimated the incidence of pes planus at as high as 40 per cent of the population. Th



Fig. 1. Special film holder for weight-bearing examination.

minor symptoms relative to the feet and no gross physical foot deformity have many times been declared fully qualified for overseas duty on the basis of their particular jobs—clerks, technicians, etc.—on the ground that their work would not entail much marching or other physical stress. Owing to unforeseen circumstances, however, soldiers have often had to resort to foot marches when it had been anticipated that their movements would always be motorized. This has caused many with

great need of further information regarding the condition is indicated by this figure and by the known etiologic role of pes planus in the production of legache, backache, and arthritic involvement of the knees, hips, and spine.

In view of the above considerations, it was deemed desirable to set up a simple x-ray technic for examination of the feet, both in repose and during weight bearing (Figs. 1 and 2), whereby the actual position of the plantar arch and its deviation from normal could be accurately deter-

¹ Accepted for publication in March 1945.

mined. Accordingly, a simple film holder was constructed for the weight-bearing examination, and pedograms (footprints) were taken in each case, both in repose and during weight bearing, for comparison with the films. To determine the role of tarsal pronation, a weight-bearing anteroposterior view of the foot was also taken by the double-exposure method (Figs. 3 and 4). In each instance a case history was obtained with special reference to antecedent trauma and to rickets and other bone disease. An attempt was made to obtain a normal standard, deviations from which would indicate either pes planus or a prepes-planus status.

Before describing the actual method of measurement and presenting the results

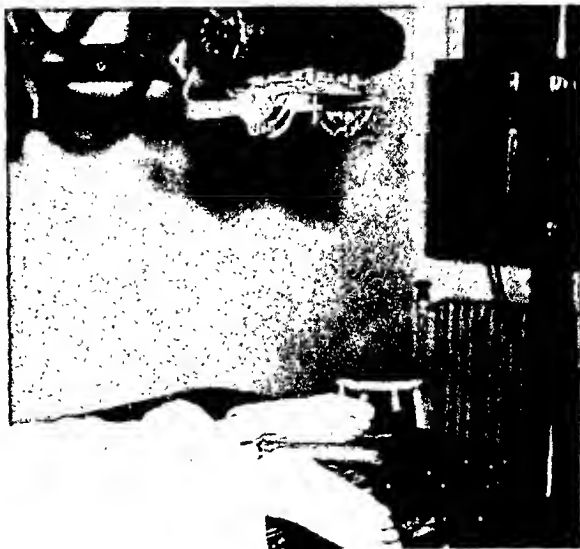


Fig. 2. Examination of feet in repose.

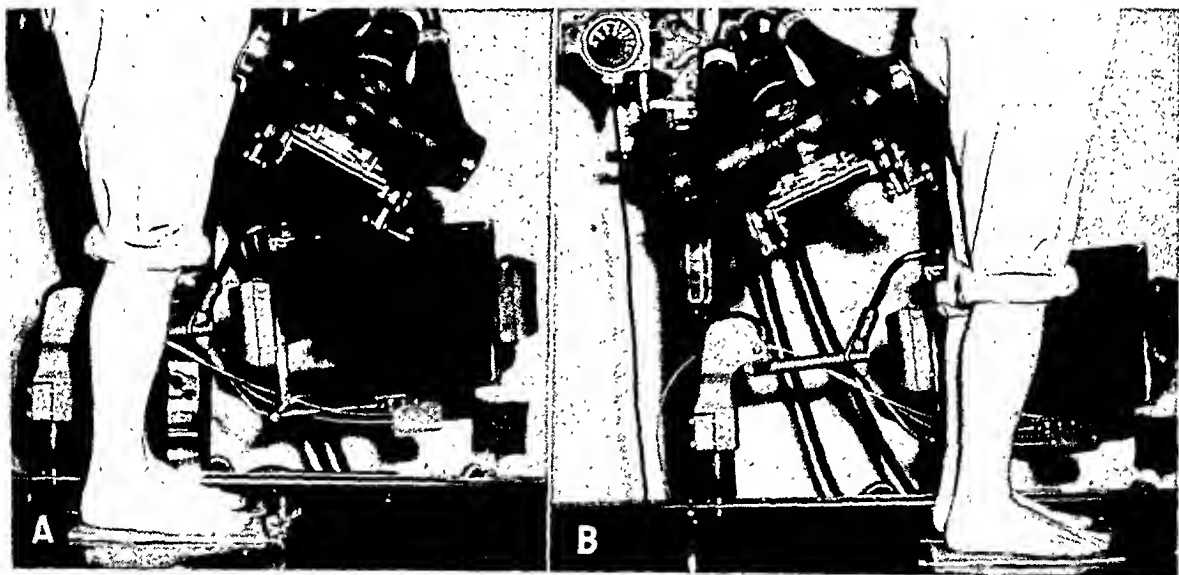


Fig. 3. Double-exposure method for study of tarsal pronation. A. First exposure. B. Second exposure.

of our survey, a brief review of the salient features of pes planus seems pertinent.

Etiologic factors in pes planus include heredity, static defects, infections, occupation, obesity, posture, and injury. Heredity plays an important role and, according to Lewin (3), the paternal parent is usually the one responsible. Infectious diseases capable of producing toxic relaxations of the supporting structures of the foot may cause flatfoot and even arthritic involvement. Congenital anomalies such

as an accessory scaphoid bone, fusion of the tarsal bones, and very rapid growth of the feet, are mentioned by Lewin as predisposing factors, although our survey revealed but few congenital defects. Poor posture may play a part. Obesity, by virtue of causing disproportion between the weight to be carried and the structure of the feet, is also to be considered. Fractures, sprains, improperly fitting shoes, and occupational trauma are known to contribute to the production of flatfoot.



Fig. 4. Roentgenogram of feet during weight bearing, double-exposure technic.

(astragalus) is placed slightly medial, with a consequent tendency to slide inward and downward.

The axes of the joints of the foot are: (1) the ankle joint, that is to say, the tibioastragaloid articulation, which runs from outward and backward to forward and inward, and

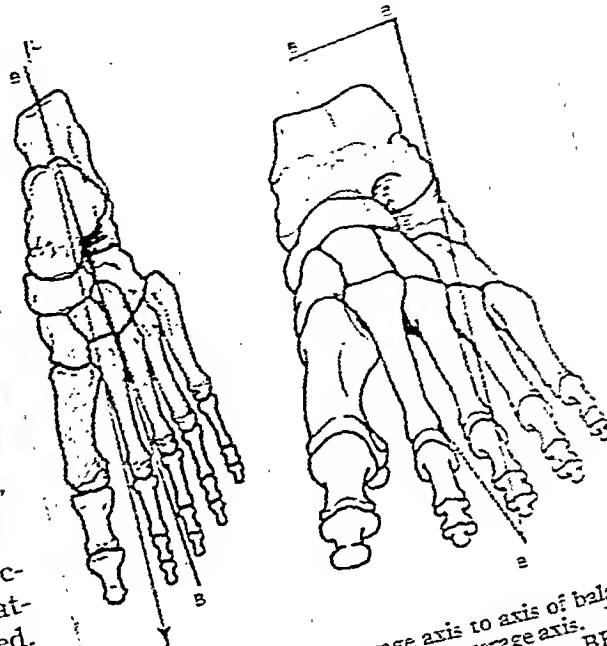


Fig. 5. Relation of leverage axis to axis of balance. The long arrow (L) represents the leverage axis. BB is the axis of balance. The plane of balance, BBB, is shown in the drawing on the right. Reproduced from Morton's "The Human Foot," by permission of the Columbia University Press.

To understand the mechanism of production of pes planus, one must study the anatomy and visualize the stress applied. The structure of the foot is a classical demonstration of the law of functional adaptation for both static and dynamic function, according to Steindler (4). In simple terms the foot consists of an arch resting on two pillars, with a superincumbent weight on the keystone of the arch. The anterior pillar consists of the metatarsal heads: the posterior pillar is the os calcis, and the keystone the astragalus. Actually there are two arches which meet at the subastragaloid articulation: the inner arch, which satisfies the primitive dynamic demand, runs forward over the neck and head of the astragalus, scaphoid, three cuneiforms, and three inner metatarsals to the heads of the latter, and backward over the articular process of the os calcis to the heel proper. The outer arch modifies the mechanical structure, allowing flexibility; that is, it controls side-swaying movements. This outer arch runs forward over the cuboid and outer metatarsals and backward to the os calcis. The keystone

allowing flexion and extension: (2) the subastragaloid articulation, which runs from backward, outward, and downward, to forward, upward, and inward, allowing pronation and supination: (3) the three axes of the midtarsal joint. These latter are the sagittal, which allows pronation and supination of the forefoot against the back of the foot; the vertical axis, which permits flexion and extension of the foot against the back part of the foot; and the front axis, which permits flexion and extension of the forefoot against the back part of the foot.

According to Morton's investigation of the foot with a staticometer, there is a functional axis, which he terms the "axis of balance," running from the center of the heel

forward between the second and third metatarsals, and a "leverage axis," extending between the first and second metatarsals (Fig. 5). He considers the foot not as a single unit, but divides it into five individual arcs conforming to the metatarsals which, when viewed laterally, are shown to be each of a separate height and length (Fig. 6).

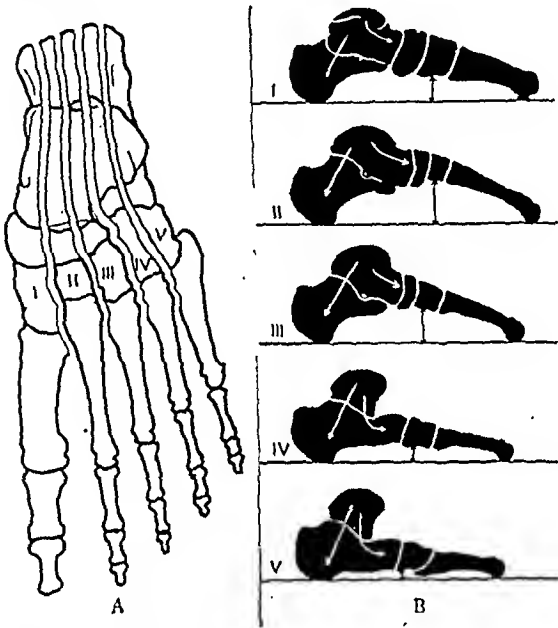


Fig. 6. Metatarsal segments of the foot. A. Suggested physiological division of the foot into longitudinal segments conforming to the metatarsal bones. B. Side view of segments with arrows to indicate the direction of weight transmission. Reproduced from Morton's "The Human Foot," by permission of the Columbia University Press.

By means of the staticometer, it is seen that the weight-bearing distribution upon the foot is proportionately as follows: os calcis 3, first metatarsal 2, second, third, fourth, and fifth, 1 each (Fig. 7).

The integrity of the foot is entrusted to the bony architecture, ligaments, and muscular apparatus. The *ligaments* which are important at the astragalotibial joint are the internal and external deltoids, controlling lateral stress; at the subastragaloid joint, the calcaneo-scaphoid, which prevents forward and downward gliding of the astragalus on the inner arch of the foot; at the remaining articulations, the calcaneocuboid, stellate, and radiate ligaments. Thus, the posterior foot is rigid

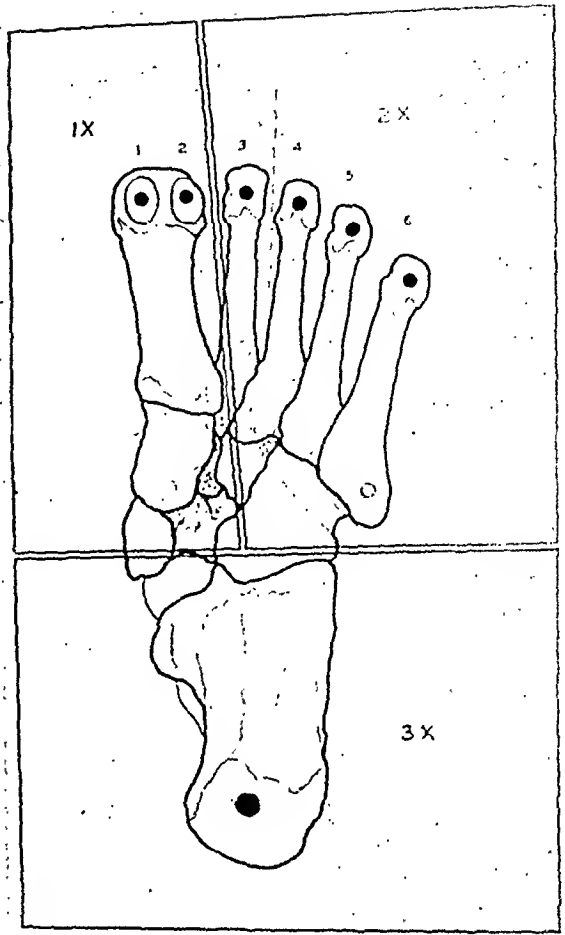


Fig. 7. Weight distribution upon the foot in stance. The black dots indicate the points of bony contact and support afforded by the metatarsal bones (and sesamoids) anteriorly and by the heel posteriorly. Little if any weight is usually borne by the base of the fifth metatarsal. The normal ratio of weight distribution in this position is 1X:2X:3X. The broken line indicates equal division of weight normally transmitted upon the fore part of the foot. Reproduced from Morton's "The Human Foot," by permission of the Columbia University Press.

and the anterior foot mobile, allowing the metatarsals and digits to adapt themselves to the supporting surface which they grip while the posterior foot deploys from the surface in walking (5).

As to the *muscles*, in the ankle joint plantar flexion is controlled by the soleus and gastrocnemius-plantaris assisted by the flexor hallucis longus, tibialis posticus, and peroneus longus. Dorsiflexion of the ankle is controlled by the tibialis anticus, the extensor digitorum, and the peroneus tertius. The subastragaloid joint depends for supination upon the tibialis posticus, assisted by the flexor hallucis longus and

common flexors of the toes. For pronation, the peroneus longus and brevis, assisted by the common extensor digitorum and peroneus tertius, are involved. The calcaneo-astragalo-scapoid joint depends for pronation upon the peroneus longus and brevis, extensor digitorum longus, and peroneus tertius; for supination, upon the tibialis posticus and anticus, flexor digitorum longus, flexor hallucis longus, and

one in the back, which is controlled by the anterior muscles. The subastragaloid joint is peculiar in that the astragalus is placed in an eccentric position on the os calcis. This keystone bone, therefore, shows a tendency to slide downward and forward, resulting in pronation of the os calcis. If the astragalus is allowed to slide forward, the whole foot will tilt over into pronation, the arch will flatten, and the

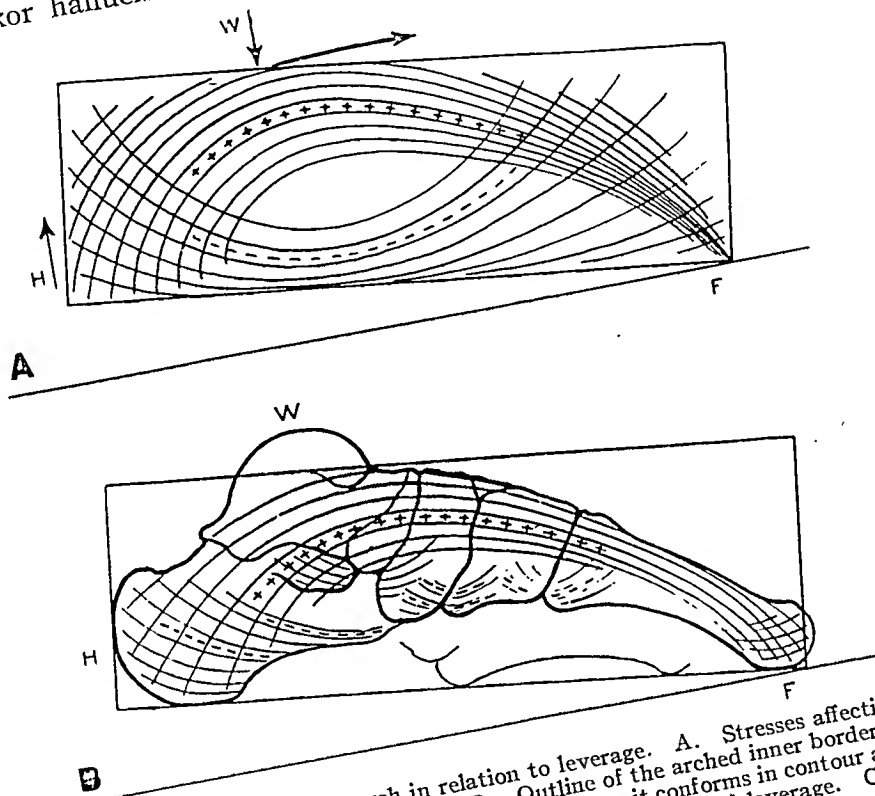


Fig. 8. Design of the arch in relation to leverage. A. Stresses affecting a block when it is used as a lever. B. Outline of the arched inner border of the human foot sketched on the block to show how it conforms in contour and in trabecular arrangement with the mechanical stresses of leverage. Compression stresses are indicated by ++++; tensile stresses by ----. Reproduced from Morton's "The Human Foot," by permission of the Columbia University Press.

extensor hallucis longus. The metatarsal phalangeal joints show minimal motion in abduction by means of the abductor hallucis and interossei, extension by the short and long extensors, and flexion by the long and short flexors.

Muscle equilibrium plays a part in the prevention and production of flatfoot. The tibio-astragaloid joint has three lines of gravity; one through the center, where there is no muscle action; one in the front, which the tendon of Achilles must hold;

inner border of the foot will become convex. This is the classical picture of flat-foot. The duty of the tibialis posticus and anticus and the toe flexors is to prevent this from happening. The tension of the peroneus longus is a further preventive factor.

Muscle dynamics in regard to the foot is synonymous with the act of propulsion. The foot is placed on the ground, with the heel first and toes extended. It then rolls over the outer border until the contact

reaches the ball of the foot. The toes then grip the surface to provide a fixed point so that the body may be pulled forward. This latter is done by flexion associated with supination of the subastragaloid articulation and abduction in the midtarsal joint. With each pronation motion of the back of the foot, there is a compensatory supinatory rotation of the forefoot, which is especially noted in flatfoot (4).

The lifting force in walking is exerted at the heel and passes forward and upward in a curved direction toward the keystone of the arch, whence it curves downward and forward to the metatarsal heads, which serve as a fulcrum. These lines of force are to be found in the distribution of the trabeculae of the bones of the foot and are identified as compression stresses (Fig. 8). Since the bony architecture of the foot is segmented, the lines of force are broken by the intervening joints. Counteracting tensile stresses are arranged in secondary systems in each bone involved, and the continuity is made possible by the plantar ligaments and fascia (1).

The principal joints involved in weak and flat feet are the subastragaloid and midtarsal articulations. In the weak foot, normal equilibrium is merely threatened, not actually disturbed, while in flatfoot, equilibrium is disturbed and morphological changes due to the relaxation of the ligaments and muscles have ensued. The astragaloscapoid joint is altered by a deforming force consisting in the rotatory component of the upper pressure applied to the center of the ball of the foot. This causes an upward movement of the forefoot against the back part of the foot, resulting in rotation of the astragalus downward and inward while the toes and metatarsals rotate upward and outward.

Shanks, Kerley, and Twining (6) noted the following morphological changes in cases of pes planus: "(1) The scaphoid and cuboid slip downward. The scaphoid may be wedged, and the upper part of the joint space between it and its neighbors may be widened. (2) The astragalus appears foreshortened, with a prominent anterior and

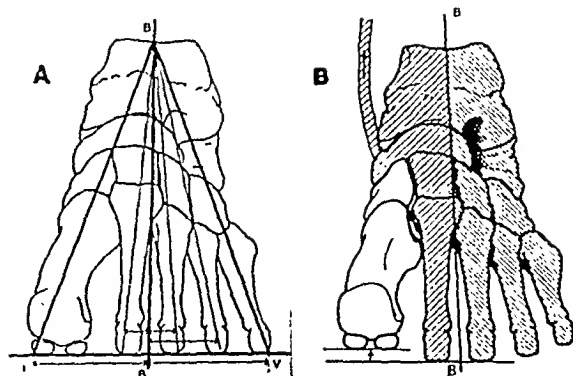


Fig. 9. A. Structural stability of the foot. Anterior view with the axis of balance (BB) in normal position between the second and third metatarsals. The first and fifth metatarsal bones furnish an equally wide margin of stability on each side of the foot (IB and BV).

B. Hypermobility of first metatarsal segment. The first metatarsal and internal cuneiform bones are unshaded to denote their ineffectiveness (through hypermobility) to contribute to the medial stability of the foot. The resulting pronation causes body weight to become concentrated upon the second metatarsal and continues until restricted by the muscles on the inner side of the ankle, or until the first metatarsal gains a firm contact with the ground.

Reproduced from Morton's "The Human Foot," by permission of Columbia University Press.

upper margin. Its anterior extremity is depressed."

It is our opinion that these changes take place as the result of compensation when the pes planus status is of extended duration. Many of the cases surveyed showed these morphological changes, which may, we believe, later lead to true arthritic states both locally and in distant joints, as a result of the alteration of the weight-bearing axes.

In the subastragaloid joint, the astragalus glides forward and downward, causing flattening of the arch and convexity of the inner border. This "break" in the middle of the foot is due to the fact that the heel is a fixed point and the ball a fixed area. As the astragalus moves forward and inward, the os calcis is forced to follow it and pivots about its point of posterior support so that the whole posterior foot becomes pronated. This is not possible in the forefoot, because of the broad area of contact. Thus, the forefoot is in relative supination and dorsiflexion as compared to the back part of the foot.

According to Morton, pronated feet show a concentration of body weight upon



Fig. 10. Roentgen measurement of the arch during repose.

the head of the second rather than of the first metatarsal, resulting in several criteria for diagnosis. These criteria, demonstrable by x-ray, are: (1) an elongated second metatarsal as compared with the first; (2) broadening of the shaft of the second metatarsal as compared with the fourth; (3) increased separation between the internal and middle cuneiforms; (4) sesamoids over the first metatarsal located proximal to the head.

Elongation of the second metatarsal and, or proximally placed sesamoids of the first metatarsal showed no apparent variation on the staticometer with the subject standing, but a kinetograph revealed a heavy concentration of weight on the second metatarsal during walking, apparently the result of leverage stresses. Broadening of the shaft of the second metatarsal is probably due to a compensatory hypertrophy as a result of an abnormal increase in function. Increased separation between the internal and middle cuneiform is an in-

dication of hypermobility of the first metatarsal segment, which consists of the first metatarsal, internal cuneiform, and the internal third of the scaphoid, as illustrated in Figure 6. This hypermobility results in the second metatarsal carrying the burden of the first, a tendency of the foot to roll inward, since the first metatarsal fails to act as a buttress, and an increase in the stress of the muscles of the internal side of the ankle (Fig. 9). Bingham found 10 per cent of patients in his clinic complaining of painful feet to have "Morton's syndrome" (7).

As observed by many investigators, footprints are of doubtful value in estimating the degree of pes planus. Our investigation showed that footprints (pedograms) are reliable for determining the degree of pronation but not of the actual descent of the arch.

The symptoms of flatfoot are fatigue, pain, and aching, commonly referred to as tarsalgia. Varying areas of tenderness are found over the tarsal area. Theoretically, disturbances in weight bearing secondary to alteration of the plantar arch would be definite factors in the etiology of arthritic involvement of the knees, hips, and spine. That this theory is correct is believed by numerous clinicians, and many of us have seen chronic back pain ameliorated by correction of a co-existing pes planus.

In our x-ray survey, we measured the distance from the base to the apex of the triangle formed by lines extended along the plantar aspect of the foot laterally. The base extended from the head of the fifth metatarsal to the posterior plantar angle of the os calcis. The posterior side of the triangle connected the plantar eminences of the os calcis, and the anterior side extended from the plantar aspect of the head of the fifth metatarsal through the plantar aspect of the proximal end of the fifth metatarsal as illustrated (Figs. 10 and 11). This method of measuring the longitudinal arch was chosen because of its simplicity and because the points involved are easily visualized. The results approached those obtained by Moreau and Costa Bertani (5).

with their method of measuring various angles of the plantar aspect of the foot.

For a part of our survey the internal longitudinal arch was used as an indicator. The measurement of the internal arch was quite consistent with the more easily established measurement of the outer arch, which foot it is believed is a true indicator of degree of involvement.

Pronation was determined on the basis of pedograms in repose and during weight bearing and double-exposure weight-bearing x-ray examination, as illustrated in Figure 3. According to Ilfeld, pronounced pronation of the foot may be present without symptoms. Two per cent of his series of patients with normal feet presented third-degree clinical pronation and 15 per cent showed second-degree pronation (1). In view of these observations, we concluded that an x-ray examination in the presence of foot complaints is a very necessary procedure inasmuch as many discrepancies are noted between the clinical and x-ray diagnosis.

Study of the tarsal internal cuneiform scaphoid joint in the clinical examination was found to lead to a diagnosis tallying with the x-ray diagnosis more frequently than the usual method of using the tarsal scaphoid as an indicator. The tarsal internal cuneiform descends in relationship to the scaphoid rather than *vice versa* in a case of pes planus. We arbitrarily set up a standard of arch measurement of 1 cm. or more during weight bearing as necessary to exclude pes planus.

It was noted that in many cases the arch was normal in repose but showed a rather marked descent during weight bearing. These cases could properly be termed, pre-pes planus or, in some cases, merely foot strain. Patients whose measurements were below the average in both repose and weight bearing were found to have fewer symptoms, in general, than those designated as pre-pes planus, presumably due to the stretching of the foot structures in cases of the latter type, whereas an already developed flatfoot was more or less compensated.



Fig. 11. Roentgen measurement of the arch during weight bearing.

Methods of therapy are many, but fall into two main groups: (1) those which tend to lift the arch and (2) those which are designed to lift the heads of the metatarsals.

Morton's method of building a lift under the heads of the metatarsals which, by failure to contact the surface, escape their share of foot stress, is an example of the latter group. Of 100 soldiers treated by this method in Bingham's series (7), 76 were sufficiently benefited to return to full military duty. Theoretically, the best of the methods designed to lift the arch seems to be that calling for a plastic plate encased in a leather pouch which is inserted in a shoe over the arch and heated with a current until the plastic becomes pliable. The patient then walks with the device in place and, by virtue of actual use, molds the plastic to fit the foot. After five minutes, the plastic becomes hardened and serves as a minor support until the arch has been forced up to a slightly higher position. The whole procedure is then re-

peated and by further repetitions the arch is theoretically replaced to a more nearly normal anatomical position.

Lack of ability to make follow-up studies on the patients surveyed prevents any definite conclusion as to proper therapeutic methods.

In those cases of our series without pes planus the x-ray measurements showed variations between 1.0 and 3.0 cm. in repose, with the average at about 1.9 cm. During weight bearing, the variation was from 1.0 to 2.3 cm., with an average of about 1.1 cm.

In cases with x-ray evidence of pes planus the variation in repose was between -0.5 cm. and +3.0 cm., with the average at about +1.3 cm.; during weight bearing, from -0.6 cm. to +0.9 cm., with the average at about +0.8 cm.

Measurements during weight bearing were arbitrarily set up for correlation with the clinical diagnosis, in degrees, as follows: normal, 1.0 cm. or above; first-degree pes planus 0.7 to 0.9 cm.; second-degree pes planus, 0.4 cm. to 0.6 cm.; third-degree, 0.2 cm. to 0.3 cm.; fourth-degree, -0.1 to +0.1 cm.

Of the cases clinically appearing to be normal, 83 per cent showed x-ray evidence of pes planus; 77 per cent, however, were either normal or of less than third degree. Thus, 23 per cent were pathological according to Army standards. Of the cases clinically showing first-degree pes planus, 9 per cent were declared normal on the x-ray examination, 36 per cent first-degree, 39 per cent second-degree, 7 per cent third-degree, and 9 per cent fourth-degree. Of the cases clinically showing second-degree pes planus, 9 per cent were normal by x-ray standards, 36 per cent first-degree, 35 per cent second-degree, 15 per cent third-degree, and 5 per cent fourth-degree. Of third-degree cases, from a clinical aspect, 8 per cent were found roentgenologically to be normal, 25 per cent first-degree, 46 per cent second-degree, 15 per cent third-degree, and 6 per cent fourth-degree. There were no cases clinically diagnosed as of fourth degree.

These findings are summarized in the accompanying table.

TABLE I: COMPARISON OF CLINICAL AND ROENTGEN FINDINGS

Clinical Diagnosis	Roentgen Diagnosis				
	Normal	First-Degree	Second-Degree	Third-Degree	Fourth-Degree
Normal	17%	24%	37%	16%	6%
First-Degree	9	36	39	7	6
Second-Degree	9	36	35	15	5
Third-Degree	8	25	46	15	6

Pronation studies led to the following observations. Of the cases which appeared clinically and roentgenologically negative for pes planus, 57 per cent showed pronation on films and pedograms. Sixty-five per cent of the cases diagnosed clinically as pes planus were negative for pes planus on x-ray examination but showed pronation. Of the cases with x-ray evidence of pronation, 61 per cent were negative for pes planus, 17 per cent showed first-degree pes planus, 10 per cent second-degree, and 5 per cent fourth-degree.

Forty colored patients and 360 white patients were examined, which is approximately the proportion assigned to this field. Of the colored group, 90 per cent showed evidence of pes planus, as compared with 72 per cent of the white group. It is believed that these percentages may be roughly correct for an over-all survey.

Patients 10 or more pounds overweight constituted only 34 per cent of the total with pes planus; of those without pes planus, 46 per cent were 10 or more pounds overweight.

A history of foot injury was obtained in 28 per cent of those with evidence of pes planus and in 33 per cent of those without.

The age incidence is as follows, though these figures are probably misleading, since the majority of military personnel fall in the age group 20 to 30:

15 to 20 years.....	7%
20 to 25 years.....	40%
25 to 30 years.....	24%
30 to 35 years.....	19%
35 to 40 years.....	8%
40 to 45 years.....	2%

Half of the cases surveyed were observed, also, for "Morton's foot" (short first metatarsal, etc.). Of this group, 42 per cent had pes planus without evidence of "Morton's foot"; 12 per cent of those with "Morton's foot" showed no evidence of pes planus.

CONCLUSIONS

On the basis of the clinical history, physical examination, and x-ray examination of 400 subjects, it is felt that the following conclusions may be drawn:

1. That many persons appearing to have normal arches but complaining of foot distress may have a basis for their symptoms, if the x-ray findings in this survey can be accepted as an indication of structural defects.
2. That the measurement of descent of the lateral arch, using the 5th metatarsal and the os calcis, may constitute an index of the degree of pes planus.
3. That pronation and pes planus may be coexistent or present individually.
4. That "Morton's foot" (short first metatarsal, etc.) may or may not coexist with x-ray evidence of pes planus.
5. That an arbitrary standard of 1 cm. for the height of the lateral longitudinal arch is the most practical for separating those cases which may be designated as pes planus from those which may not. This conclusion is based on the number of cases falling above and below this measurement in this survey.
6. That, in this survey at least, the incidence is higher among colored persons (90 per cent) than among whites (72 per cent).
7. That, contrary to the findings of other investigators, overweight (10 pounds or more) did not seem to be a factor in the incidence of pes planus.
8. That pes planus is an important physical condition resulting in far-reaching body changes and should be given more recognition by both radiologists and the general medical profession.

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Langley Field, Va.

CLINICAL NOTES

Capt. D. R. Baker, M.C., A.U.S.

Captain Bonnet has asked that I discuss the clinical application of this survey. It has been my opportunity to see a majority of the cases studied. These comprised all types of foot and arch deformities and so-called normal feet, as well as frank cases of flatfoot. Both sexes are included.

It is clear that if the measurements obtained from the x-rays can be accepted as an adequate determination of the presence or absence of pes planus, one's clinical judgment is seldom correct. This is demonstrated by the finding of pes planus in 83 per cent and pronation in 57 per cent of so-called clinically normal cases. At first, I was skeptical of the findings, because the measurements were made from the lateral aspect of the plantar arch. When, however, measurements were made on the same films, using the medial aspect of the arch, the difference was found to be negligible.

The study has been of inestimable value in differentiating between pes planus and pronation and in borderline cases of pes planus in respect to duty assignments. It is my feeling that such studies are indicated in order better to evaluate and treat all cases of painful feet in which some defect of the plantar arch is suspected.

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Pneumoconiosis Due to Cotton Dust (Byssinosis)¹

A Case Report

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BYSSINOSIS, a form of pneumoconiosis due to prolonged inhalation of cotton dust, has long been recognized as a cause of ill health among British cotton-mill workers. In 1936, C. Prausnitz (2) and co-workers, under the auspices of the British Medical Research Council, published an account of their extensive investigations into the causes of respiratory disease in this industrial group. A brief review of this work follows.

Sickness caused by respiratory disorders is frequent in cotton mill operators, particularly those working in departments in which there is a continuously high content of cotton dust in the air. Many operators working in such departments experience a typical illness, referred to as "stripper's asthma" or "cotton-mill fever," an insidious disease characterized initially by evidence of upper respiratory irritation with moderate fever. The first attack soon subsides, but with continued employment in this type of work a dry irritating cough and attacks of breathlessness develop, with a sense of constriction in the chest. These symptoms are aggravated on return to work on Mondays after a week-end of absence from the mill. In a period of years, symptoms become more severe; "Monday-morning fever" continues into later days of the week, with aggravation of symptoms. The cough grows worse, becoming spasmodic, with production of small quantities of sticky, tenacious sputum. If the affected person quits the mill before symptoms become too severe and enters some type of out-of-door work, these disappear and health is regained. If, however, he remains in the same type of employment, he becomes progressively worse, with a prospect of invalidism with emphysema, bronchitis, and ultimate cardiac failure. Fletcher, co-worker of Prausnitz,

examined radiographically 100 persons with "mill fever." He describes the appearances as those of chronic bronchitis with associated emphysema; there were no particular roentgen features specific for the disease.

A short summary of the findings and experimental observations of Prausnitz and his co-workers follows:

1. Card-room air of cotton mills is rich in dust particles less than 2 microns in diameter and still richer in ultramicroscopic particles capable of easy penetration into deep air passages.

2. The protein fraction of cotton dust has an irritating effect upon the deeper tissues of the lungs and produces definite inflammatory lesions. Animals subjected to prolonged inhalation of cotton dust showed marked thickening of the inter-alveolar septa as a result of edema, leukocytic and dust cell infiltration.

3. Patients working in cotton mills who develop "card-room fever" all become hypersensitive to cotton-dust protein. Evidence of anaphylaxis could be produced by intracardial injection of cotton dust into animals which had been previously sensitized by parenteral injection of the cotton-dust protein or by prolonged inhalation of the dust itself.

4. Physiological tests showed definite impairment of respiratory function in a large portion of cotton workers suffering from respiratory diseases.

The British workers conclude that it is important that persons complaining of respiratory diseases be removed early from the injurious working conditions (high cotton-dust air content) before secondary changes develop in the lungs.

Trice (3) and Bolen (1) have written of the hazard of byssinosis in America and suggested means of prevention. Bolen reviews the literature.

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CASE HISTORY

A white male, 21 years of age, a native of a south-eastern state, entered the hospital on Jan. 13, 1943, ten weeks after induction into the Army. For several days he had not felt well, because of a cold. On admission, he complained of weakness, sore-throat, chills, cough, and pain in the chest. His temperature was 102.2° F., pulse 104, and respirations 32.

The patient stated that he had not been very well for several years. His only definite illness, however, during that period had been an attack of "flu" in 1938, at which time he was sick for one week. He had a similar illness in the spring of 1940, with loss of several days from work. On recovery he had returned to his place of employment, where he had remained as an employee until induction.

In January 1940, the patient had started working in a cotton mill, where he was employed as a quilling machine operator in a weaving room. In this room there was always a fine, misty dust, which settled on the looms and other machinery. At intervals the looms were cleaned with an air hose, and at such times the air of the room became very dusty. The patient did this type of work on several occasions as a spell job. He stated that, after working in the mill for six or eight months, he asked for a lighter type of work, not feeling up to the duty to which he was then assigned. Such an adjustment was made, and he got along rather well.

The family history was irrelevant with the exception that a sister suffered from asthma.

The patient was a well formed young man, rather slender, not appearing particularly sick and with no gross abnormalities. The membranes of the nose and pharynx were moderately injected. Repeated examinations of the chest during his hospital stay showed no abnormal findings. The rest of the physical examination was essentially negative.

A roentgenogram (Fig. 1) taken shortly after admission revealed large patchy densities throughout both lung fields. These were at first thought to be associated with the upper respiratory infection from which the patient was suffering, but though he recovered from his illness within three or four days, the roentgen appearance remained unchanged for a period of two months, during which he was under observation. For an interval during this time, he was receiving potassium iodide therapy.

With the exception of a slightly increased sedimentation rate, all laboratory studies were negative. These included spinal fluid examination, a blood Kahn test, blood culture, repeated sputum examinations for tubercle bacilli, and several for fungi. The red blood cell count was 5,000,000, the white cell count 8,800, with 80 per cent polymorphonuclears and 20 per cent lymphocytes. The urine was normal. The blood sedimentation test one month after admission was 14 mm. in thirty minutes and 27 mm. at the end of one hour. An old tuberculin intradermal skin test was negative.



Fig. 1. Roentgenogram showing large patchy densities throughout both lung fields.

SUMMARY

This case is presented as one of pneumoconiosis (byssinosis) due to prolonged inhalation of cotton dust. The diagnosis is based on the history of employment as a cotton-mill worker for a period of about three years just prior to hospital admission, together with an analysis of the clinical history and the patient's activities during this period. For the two months he was under observation, the findings as seen in the chest roentgenogram made on his admission for a minor respiratory ailment remained unchanged. These we can only explain as due to byssinosis.

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An Unusual Case of Multiple Chondromata¹

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MULTIPLE chondromata involving the hands and feet are not common, while involvement of a long bone in addition to the hands and feet was present in only 3 of Geschickter and Copeland's series of 71 cases (1, a). In a careful study of the literature no record was found of skeletal changes as extensive as those in the case reported below, although several instances of multiple chondromata have been described (2, 3, 4).

CASE REPORT

The patient, who gave his age as 21, but looked younger, was asked to come into the dispensary for study when marked deformity of his hands and arms was observed. His mother stated that his birth was normal, and that he was breast-fed for one year. Cod-liver oil was administered in small amounts (exact quantity not known) beginning at 16 months of age. When the boy was approximately two years old, his mother noticed that his hands were deformed. A local doctor made a diagnosis of rickets and advised large doses of cod-liver oil, but no improvement resulted. The patient states, curiously enough, that he was not conscious of the deformity of his hands and arms until he was fourteen years old. He is certain that since then there has been no change in their appearance. He avoided athletics in high school, but otherwise his activities were not restricted. He studied stenography and became sufficiently proficient to type 60 words per minute. He is now employed in the capacity of a clerk.

At the age of 7 he had scarlet fever without complications. In 1939 he fractured his right femur in a sleighing accident, but no evidence of the fracture is seen on x-ray examination at this time. In 1943 tonsils and adenoids were removed. For several months prior to this, fleeting pain occurred in various joints, but this disappeared shortly after tonsillectomy.

The patient's mother is 61 and has "heart trouble." His father is 62 and well. He has four brothers and four sisters, all of whom are well except one brother, who has a peptic ulcer. No visible deformity similar to his is present in any other member of the family. Unfortunately the other members of the family could not be x-rayed.

Physical Examination: The patient is 5 feet 8 inches tall and weighs 125 pounds. His skin is clear and no hemangiomas are present. His

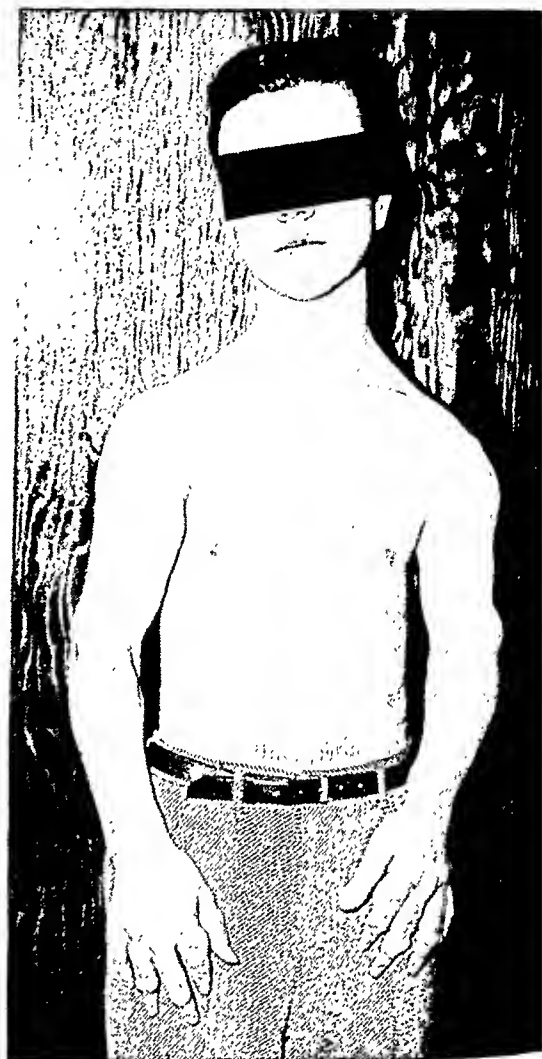


Fig. 1. Photograph of patient showing short left arm and deformed hands.

shoulders are narrow and drooping, the left more than the right, with shortening of the upper and lower arm. The muscle development is normal and strength good. The upper left arm from the acromion to the head of the radius measures 18.75 cm. and the right upper arm 20 cm. The left lower arm from the head of the radius to the styloid process is 20 cm. long and the right lower arm between the same anatomical points measures 22.5 cm. (Fig. 1).

Both hands are markedly deformed. Hard fixed nodules, from 1 to 2 cm. in diameter, are palpable on the dorsal surface of the right second, fourth, and fifth metacarpals and on the proximal phalanx of the thumb. Similar nodules are present on the interdigital surfaces of the proximal and middle

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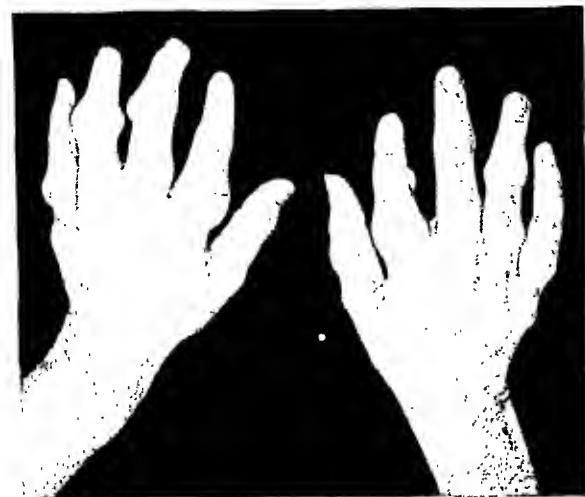


Fig. 2. Deformity of the fingers due to chondromata in the proximal and middle phalanges.

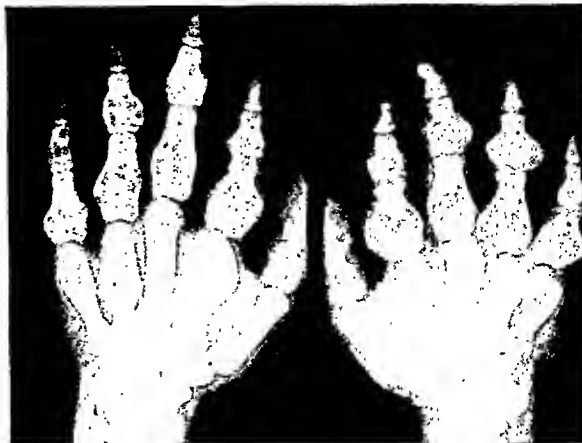


Fig. 3. Roentgenogram taken in December 1944, showing multiple chondromata involving the metacarpals and proximal and middle phalanges. Compare with Figure 4.

phalanges of all the fingers. When bilateral, they give the finger a fusiform appearance. On the left hand, similar nodules are present on all the metacarpals, proximal and middle phalanges of the fingers, and proximal phalanx of the thumb. The skin is movable over these nodules and none is tender to pressure. The nails appear normal. The left middle finger is deviated medially, and flexion of the left hand is incomplete (Fig. 2).

The second toe on the left foot is everted, and the third toe is short. The fourth toe on the right foot has a firm nodule on its lateral aspect.

The patient has a light beard but no axillary hair. The first lower molar on the left and second lower molar on the right have been extracted. The remaining teeth appear normal. Aside from a moderate sized varicocele on the left, other physical findings are normal.

Laboratory Findings: Blood studies show hemoglobin 15.6 gm., red cells 5,800,000, white cells 4,800 (polymorphonuclears 28, lymphocytes 66, stabs 1, monocytes 4, basophils 1). The urine has a specific gravity of 1.010, with no albumin and no sugar; microscopic examination is negative. The blood phosphorus (5.2 mg. per cent) and phosphatase (15.7 Bodansky units) are slightly elevated; blood calcium (11.2 mg. per cent) is within normal limits. None of these findings is suggestive of hyperparathyroidism.

X-Ray Examination: Roentgenograms of the hands reveal a remarkable picture. All the metatarsals and proximal and middle phalanges of the hands show central translucent and rarefied areas with visible trabeculae, at times giving a honeycomb appearance. The cortex is thin and expanded. The distal phalanges seem to be spared except for the left middle finger. The picture is one of multiple chondromata (Fig. 3).

Through the courtesy of Dr. L. G. Allen, a roent-



Fig. 4. Roentgenogram of the hands taken in 1939. Comparison with a more recent film (Fig. 3) shows little change in appearance of the lesions over a five-year period.

genogram of the patient's hands taken in December 1939 was obtained (Fig. 4). The report reads: "These films show broadening of the shafts of the metacarpals and phalanges with cyst-like expansion of the shafts at the diaphyseal extremity Deformity of the fingers is the result of this cyst-like deformity of the bones. The picture is that of multiple enchondromata. No spurs of the cortex are demonstrated and the articular surfaces are uninvolved." A comparison with the more recent films (Fig. 3) shows no striking change in the appearance of the bony lesions during the five-year interval. There has, however, been an increase in length and width of the metacarpals and phalanges.

The findings in the shoulder region are equally striking. The coracoid processes are translucent, with fine trabeculae. The upper part of both humeri are widened and show severe distortion of

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Roentgenographic Demonstration of Concretions in the Submandibular Glandular Duct by Use of Intraoral Films¹

GEORGE D. MONARDO, R.T.²

BECAUSE CONCRETIONS in the submandibular glandular duct are difficult of demonstration by the ordinary technics, the diagnosis may not always be made correctly. The postero-anterior projection usually employed may show the stone, but more often it does not and therefore is frequently of little or no diagnostic value.

a positive finding (Fig. 1). This is also true of submandibular glandular duct stones, which occasionally have been demonstrated in roentgenographs of the condyle and angle of the mandible (Fig. 2).

The best method of demonstrating a concretion in the proximal portion of Wharton's duct and in the sublingual area

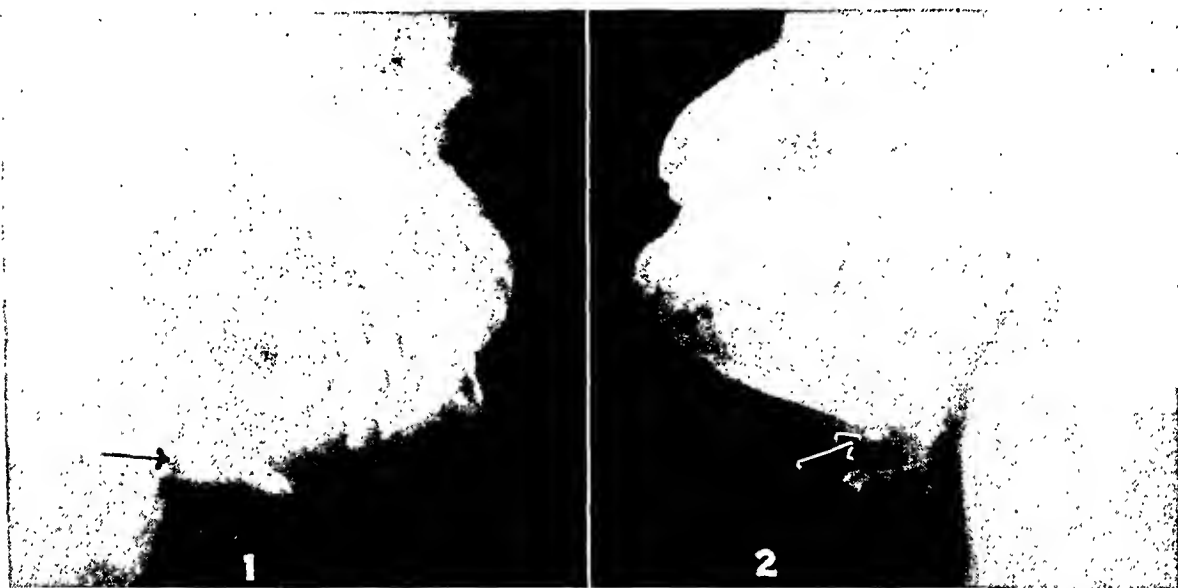


Fig. 1. Shadow of stone imposed upon the body of the mandible.

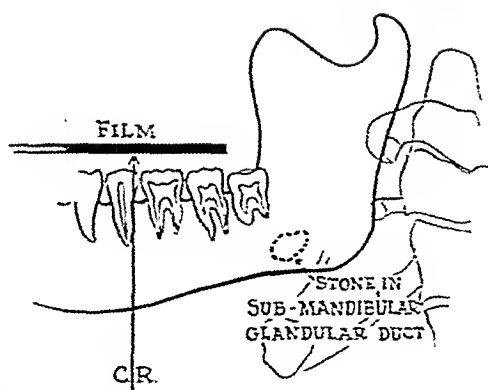
Fig. 2. Stone in the submandibular glandular duct, demonstrated in a roentgenograph of the condyle and angle of the mandible.

In the lateral view of the mandible the right and left portions are superimposed, and the stone may be demonstrated only if it lies below the bony structure. A lateral view of the mandible on the involved side may show the concretion. A stone in the sublingual area is shown best in the roentgenograph of the body of the mandible. Even in such a view, the shadow of the stone may be superimposed on that of the body of the mandible and, if the density be the same as that of the bone, or less, may fail to be interpreted as

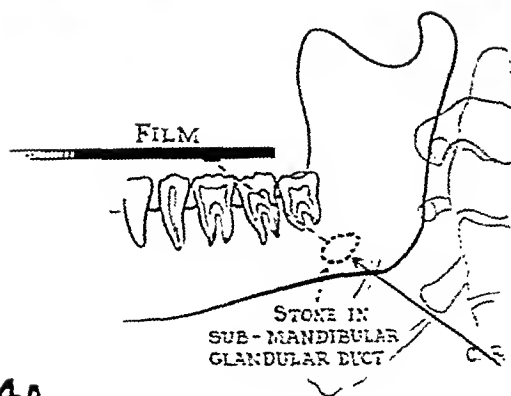
is by intraoral occlusal films, 2 1/4 by 3 inches, in the infero-superior or submento-frontal position. These projections are usually taken with the patient in a dental chair, with the head well back against a suitable support (Fig. 3). An occlusal film is placed between the jaws, well back and toward the side being examined, so as to include the whole of the gland. It is held in place by the teeth, with the central ray at right angles to the film. This demonstrates a concretion in the sublingual area very well but does not always

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² On leave from the Department of Radiology, University of Minnesota, Minneapolis, Minn. On duty with the Armed Forces overseas.



3A



4A

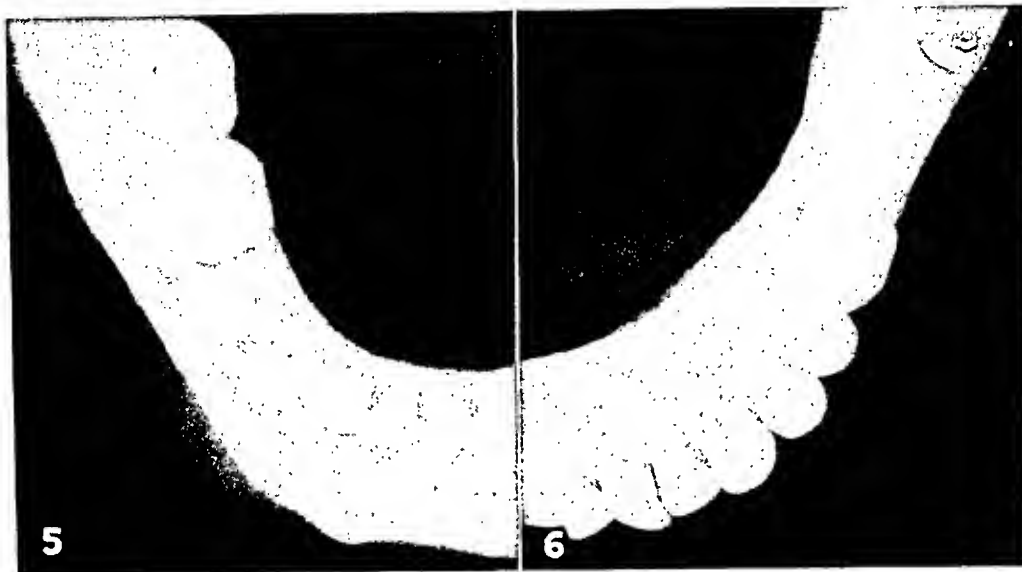
Fig. 3. Technic for demonstration of a stone in the sublingual area; the ray projected at 90° will not demonstrate a stone in the submandibular duct, as shown in 3A.

Fig. 4. Position of patient for demonstration of a stone in the submandibular area; the ray is projected at an angle of 45° to the film, as shown in 4A.

demonstrate one in the submandibular region (Figs. 5 and 6).

In the submandibular area a concretion is best shown by the following method. An occlusal film is placed in the patient's mouth as described in the preceding paragraph. If the concretion is on the left side, the film is placed to the left. The

patient's head, well back on the support, is rotated to the right. The left area of the submandibular glandular duct is next to the tube and is being examined (Fig. 4). The tube is placed as close to the area to be examined as possible, usually at a distance of 25 inches, since in this particular position the patient's shoulder, as a rule,



Figs. 5 and 6. Views made with technic shown in Figure 3.



Figs. 7 and 8. Views made with technic shown in Figure 4.

does not permit contact distance. (Contact distance can be obtained only in the right-angle or 90° projection.) The central ray is projected at an angle of 45° to the film, entering the mandible at its angle, (Fig. 4A). This is done for two reasons. The occlusal film has been placed as far back in the mouth as possible but is not directly above or superior to the concre-

tion, so that a ray projected at 90° does not cast a shadow on the film (Fig. 3A). The second reason is that an angle of 45° is required to project the proper shadow onto the film. The teeth are, of course, distorted. The stone therefore casts a proper shadow upon the film and the correct diagnosis can be made (Figs. 7 and 8).

Technical details are as follows:

I. Sublingual area

Film: Eastman superspeed occlusal dental film

Positioning: Intraoral occlusal, as far back as possible

Central ray: Inferosuperior, perpendicular, 90°

Distance: Contact with dental unit or 14 inches

Ma.: 10 dental unit

Volts: 110

Kilovolts peak: 60-65

Time: 3 seconds

II. Submandibular area

Film: Eastman superspeed occlusal dental film

Positioning: Intraoral occlusal, as far back as possible

Central ray: Inferosuperior at 45° angle to film

Distance: 25 to 30 inches

Ma.: 10 dental unit

Volts: 110

Kilovolts peak: 60-65

Time: 6 to 8 seconds

SUMMARY AND CONCLUSIONS

Two new positions for demonstrating concretions in Wharton's duct and in the submandibular area have been described. Intraoral occlusal dental films are used. It is pointed out that both the 90° projection to the occlusal film and the 45° central ray projection should be employed. The latter projection will superimpose the shadow of the concretion on the film. With these two satisfactory intraoral occlusal roentgenographs, no additional exposures will be required.

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Protection Against X-Rays and Gamma Rays

A Combined Report of the Standardization Committees of the American Roentgen Ray Society and the Radiological Society of North America¹

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The following report is a compilation of parts, each written by an outstanding authority on his particular subject. Its purpose is to acquaint those who have recently become engaged in the use of x-rays and radium with the actual hazard involved and also to reassure them against imaginary and mythical dangers often associated in popular story with this potent and yet invisible agency.

The penetrating radiations gained a bad reputation because of the fact that the early workers invariably received injuries. Some of them died, and a few are still alive with disfiguring lesions on their hands or elsewhere on their bodies. These injuries were the price they paid for being scientific pioneers. Today, with the accumulated experience of many workers over a period of half a century, the facts concerning the penetrating radiations are so well known that, if the protective measures for their proper use

are followed, there is no reason why anyone should receive any injury whatever.

With the expanded use of the penetrating radiations in industry, however, we face two dangers rather than one. First is the actual chance that, where radiation is improperly used, someone will receive a real injury. Second is the mental hazard of those who are in reality perfectly safe but, being misled by legend, may believe themselves to be in danger.

The papers which follow are the result of a combined effort by the American Roentgen Ray Society and the Radiological Society of North America, which societies include all of the trained radiologists and radiologic physicists in the United States and Canada. This paper should serve to inform and to reassure those interested.

K. E. CORRIGAN, Ph.D.

Chairman, Standardization Committee, The Radiological Society of North America.

The Tolerance Dose or Tolerance Intensity

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In view of the serious damage which may result from too much exposure to radiation, it becomes extremely important to determine the amount which can be tolerated without producing any undesirable effects. The first impulse might be to say that *all* irradiation should be avoided, and then no reaction could be produced, no matter how low its threshold. Besides the impracticability of this from the point of view of the construction of protective barriers, it is

actually impossible because of the nature of the world around us.

The entire earth and all its inhabitants are continually bathed in ionizing radiations of low intensity. Some of these, *cosmic rays*, come from outside the earth's atmosphere. Some, *earth radiation*, come from our terrestrial surroundings. The earth's crust and all natural waters contain measurable amounts of radioactive matter; in general the concentration does not vary

¹ According to the decision of the two Societies, this report will be published in both medical and industrial journals. It has appeared in *Industrial Radiography* 4: 35-43, Dec. 6, 1945.

greatly from one locality to another, except in the neighborhood of large deposits of uranium ore. It has been estimated that there is considerably more than 1 gram of radium per square kilometer of the earth's surface and, of course, the gamma radiation from this material is everywhere present. Furthermore, every individual ingests and inhales radioactive matter in food, drink, and air, so it is estimated that a person, by the time he reaches middle age, has approximately 0.015 microgram of radium fixed in his body. The alpha and beta rays from this bombard cells which otherwise would not be reached by these non-penetrating radiations.

It is evident, therefore, that it is impossible to avoid some irradiation and that, in fact, all human development has occurred in the face of such exposure. It may be that a certain intensity of irradiation is now essential to human well-being. It has even been suggested that it has played a part in human (and other) evolution, in view of the genetic changes known to have been induced by ionizing rays.

Be that as it may, the total of these unavoidable irradiations, to the extent of approximately 0.001 r per day, is certainly tolerated continuously by human beings. The question is, how much greater intensity can likewise be tolerated in irradiation of the entire individual. Further, it is important to decide whether this "tolerance intensity" can be increased if the radiation is applied to only a small part of the body, such as the hands of a radium worker.

In animal experiments it is possible to administer progressively higher doses of radiation, protracted or concentrated in various ways, and find the levels at which different types of damage occur. It is impossible, however, to transfer these data to human beings, since the radioresistance of different species varies enormously. Accordingly, the only practicable procedure is to investigate cases where individuals have been exposed to determinable intensities of radiation over long periods, without any evident effects. This is not easy

to do, and any conclusions must necessarily be based on certain assumptions as to working hours and working habits over several years. During the period from 1925 to 1932, however, several such investigations were published, each one based on a very limited number of individuals. These articles had been published before the measurement of radiation in terms of roentgens had become generally feasible, and the recommendations were made in terms of a fraction of an "erythema dose" per month. A summary of these reports leads to an average figure of 0.01 erythema dose per month as a safe limit. Accepting the figure of 600 r as an erythema dose for moderately hard x-rays, and a working month of 24 days, one arrives at 0.25 r per day as the safe dose.

The figure of 0.2 r per day has been rather widely accepted as the intensity of x- or gamma radiation which can be tolerated continuously. However, in view of the facts that this result was obtained with moderately low-voltage x-rays and that the same intensity of the more penetrating radiations obtained with higher voltages or with radioactive materials would deliver considerably greater doses to deep-seated organs, the American Advisory Committee on X-Ray and Radium Protection has felt it desirable to reduce this to 0.1 r per day. This is to be interpreted as 0.1 r during any 24-hour period. It does not follow that 0.7 r at any one time during a week, or 3 r at any one time during a month is permissible.

This intensity of irradiation, over long periods, will produce no detectable effect in the individual. No blood or tissue change, or any other reaction, was observed in any of the persons whose records contribute to the accepted figure. The accumulated dose is far below that necessary to produce blood changes, sterility, or any other of the non-genetic effects described in this report.

With regard to genetic injury, it is not possible to be equally dogmatic. The subject is discussed in another section of this report. In the light of available in-

formation on genetic damage, it appears that, while no positive statement can be made regarding the improbability of genetic injury from any exposure of 0.1 r per day, the chance that it will occur to any significant extent seems fairly remote.

All of the foregoing has applied to irradiation of the entire individual. It is well known that when only a small portion of the body is exposed, considerably higher doses can be tolerated. Local exposure is usually more difficult to determine than general. There is never any excuse for local exposure with x-rays; all parts of the body can be protected to the full tolerance limit. However, it may be difficult or impossible to avoid overexposure in the handling of radioactive substances, either natural or artificial, where

the manipulation of small sources must be carried out. For a person learning a new technic, the exposure is almost inevitably greater than for the skilled operator, and this must be taken into account in determining procedures. There are few or no direct data on intensities which may be tolerated on the fingers, for instance, and indeed there appear to be considerable individual variations according to the quality of the skin and the care which is taken of the hands. For the present, it is recommended that the rate of local exposure to fingers or hands shall not be more than ten times the tolerance rate for general exposure and shall be kept lower if possible. No other part of the body should be subjected to more than the tolerance dose for the entire body.

Radiation Injury

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The effects of the radiations from x-ray tubes (x-rays) and from radium (gamma rays and beta rays) on the human body are quite well known, because these rays have been used by physicians for nearly fifty years. Since the effects of the three are similar in broad outlines, we will use the term "radiation" in this section for them all, in order to avoid repetition.

At the outset it should be emphasized that there are no "mysterious" effects. While these radiations may seem mysterious to those who have not used them, their behavior is governed by definite physical laws which are known to those who have made a study of them. The radiations being considered here may have very harmful effects; yet so may sunlight, electricity, and a great many other common things if they are not properly used. When controlled, they can perform useful service to man without injury; but, as with other things, when improperly used they may injure people, and the injuries they cause are known. The injury may

be the result of a single severe overexposure or of multiple small overexposures of local parts of the body, as the hands, or of the whole body.

Acute Local Overexposure: If a person exposes any part of the skin surface to a large quantity of these radiations, he gets what is called an "acute" reaction. This reaction resembles a sunburn in some respects. The skin becomes red; it may blister if the dose is large enough, and ulcers may form if the dose is very large. One difference from sunburn is that it takes many days for the reaction to develop. When the exposure is just sufficient to produce a faint reddening of the skin, the color may not appear for a month. If the exposure is very great, the reaction may appear in a few days. Sometimes a faint redness is apparent a few hours after the exposure and then goes away only to return again and get worse several days later. Another difference from sunburn is that these reactions take longer to heal and are more painful. When they heal,

they leave the skin tanned if there has been no blister, or white and dry, and thin, if there has been an ulcer.

Such effects as those just described should never result from any industrial work or medical radiography. They require large amounts of radiation such as physicians use in treating cancer. They can result, in industrial radiography, only from gross carelessness or ignorance of how to control the radiations.

Repeated or Chronic Local Overexposure: When the single exposures are not large enough to cause the reactions described above, they may still cause changes in the skin which are not visible to the eye and not felt by the person. Yet, they are very real. If only one such exposure occurs, it has no significant consequences; but when similar exposures occur day after day or week after week, trouble finally develops. Just how and when these changes occur depends upon the amount and the quality of the radiation to which the part was exposed. If the amount received is just below that required to cause a redness and it is frequently repeated, a reaction will eventually develop that is much like that from a large single dose. If the amount is, say, one hundredth part of that required for an acute reaction and it is repeated every day or two, it may take a year or more for any trouble to appear. The "trouble" will not resemble a sunburn at all. The skin will become tight; its wrinkles and ridges will disappear; it will be dry and shiny and it may be slightly red. Later on, crusts or warts will appear. In a few people these crusts and warts will turn into skin cancer.

Such changes as these are found on the fingers of dentists who habitually hold films in patients' mouths; on the hands of physicians who work under the fluoroscope without proper protection or who hold babies or other patients too frequently while taking radiographs; on the hands of anyone handling inadequately protected radium repeatedly; on men improperly holding metal or other industrial materials while making industrial radiographs.

It must be emphasized that years of continuous exposure may be required for these changes to develop, without warning meanwhile of the impending danger. Many of the pioneers in the medical application of x-rays and radium found that their hands and other parts of their bodies were damaged years after they had started their work. Many physicians who did not understand how to use x-rays were called upon to use them during World War I and, after the war, "trouble" developed.

Such changes *need not* come about. The physicists have instruments to measure these radiations and we now know how much radiation a person can tolerate. If the radiation about any job is measured (as it can be) and if conditions are modified to keep this radiation to a low level (as they can be), no one need be damaged.

Local Irradiation of Hair-Bearing Areas: Hair can be made to fall out by amounts of radiation that are just less than those required to produce an acute or even a moderate reaction of the skin. Hence massive falling out of hair is an indication of overexposure. If the dose is just enough to make the hair fall out, it will grow in again in a few weeks or months. Repeated exposures of this kind result eventually in the chronic changes described above. Frequently, in such cases, there is another change not seen so often on the hands, namely, the appearance of many irregular red blood vessels just under the skin, so-called, "telangiectasis."

Effects on the Testicles and Ovaries: The effects of repeated exposures of the testicles or ovaries will be described elsewhere. It should be understood, however, that impotence, that is inability to have sexual relations, is not a result of irradiation. After excessive overexposure, as in medical treatment for cancer, the ability to produce children may be lost temporarily or permanently, but not the ability to perform or enjoy the sexual act. This amount of radiation could not possibly be received in an industrial accident without other and more obvious injury accompanying it.

Radiation to the Entire Body or Large Portions of It: We have been discussing largely the effects on local areas of skin. If the entire body is exposed, other changes result. Excessive overexposure of the whole body—to an amount that would cause redness in a local area—will result in death. Smaller doses will cause various changes that can be detected because other parts of the body than the skin are changed.

The *blood* is one of the most important elements of the body that is affected early and by relatively low overexposures. The blood contains red cells and white cells, the white cells being the more easily affected. Doctors can count the blood cells, both white and red, and hence can detect early radiation injury before it becomes serious and can measure the extent of damage done. When speaking of the blood, we include the bone marrow, because it is there that many blood cells are formed. The blood, like the skin, is affected by both large overexposures and by chronic repeated smaller overexposures. Large exposures cause a decrease in the number of all types of cells, but the effect is first seen in the white cells. With repeated low-level overexposures, the white cells are likely to be the only ones to show the effect until very late.

If the overexposure persists for a considerable period, there will develop in a certain number of people a "cancer of the blood" called leukemia. This is rather rare but can be caused in animals by irradiation over prolonged periods. In other people an anemia will develop, due to the fact that the bone marrow cannot produce enough red cells for the blood.

Because of these possibilities, it is necessary for people who are exposed or possibly exposed to radiation to have the blood examined at regular intervals by a qualified physician. If the changes are detected early, a change of occupation can be effected, and recovery from the effects will follow. Especially important is it that the working conditions and the protection of the apparatus be changed so that no one else is overexposed.

There is another group of tissues in the body, known as *lymphatic tissues*, which are easily affected by radiation. Since some of the white blood cells are produced by these tissues, changes in them are picked up by examining the blood. If these tissues are affected too much and too long, they may change into another form of cancer, called lymphoblastoma. Few, if any, people have been known to have this disease as a result of overexposure, but it is common in overexposed animals and is sometimes associated with leukemia.

Overexposure of radium miners to a gas that comes from radium is suspected of causing cancer of the lungs. This disease has not been associated with overexposure to x-rays or to radium as handled in medical or industrial work.

In radium watch dial painters who swallowed radium, and as a result had radium deposited in their bones, *bone* diseases developed as a result of the local irradiation. These were (1) a local weakening of the bone with pain, (2) an infection of the bone (osteomyelitis), and (3) cancer (sarcoma) of the bone. No such changes have been found from radiation coming from the outside to the whole body.

There are some *general symptoms* that develop from irradiation of the whole body or from heavy overexposure of parts of the body. The mildest of these is nausea with loss of appetite. This may come from so many other conditions of work or upset home life that it is difficult to relate it directly to industrial exposure to radiations. The next more severe symptom is vomiting. It takes quite large doses of whole body exposure to produce this in an otherwise healthy individual. In most instances, some other cause than radiation must be sought, unless a heavy exposure is known to have occurred. General weakness and tiredness are not due to overexposure itself but will accompany a chronic anemia from overexposure, as they will accompany anemia (loss of blood cells) from any other cause.

In conclusion, it must be pointed out that all of the above conditions are preventable.

Radiations can be measured by properly qualified physicists. The "safe" dose is known. The dose necessary to cause the above changes is known to a degree. The apparatus for both medical and industrial work can be so protected that the amount of general and local radiation is well below the safe level. Proper medical care can

do much to alleviate symptoms but cannot restore a severely damaged individual to normal. Early changes may be picked up by medical examination, but late changes may occur without early signs or symptoms that would be apparent to an untrained person. Prevention of exposure is the keynote for safety.

Genetic Injury

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Exposure of mature sperm or ova to x-rays before fertilization results in abnormalities of development. When such abnormalities reappear in succeeding generations, it is plain that the cytologic changes induced occurred in the hereditary elements. In certain plant and animal forms where special cytologic and breeding tests can be performed, it has been shown that some of the abnormalities can be correlated directly with chromosome aberrations (deletions, inversions, and translocations) and also with gene mutations.

In the fruit fly, *Drosophila*, such developmental abnormalities may be a change in the shape of wings, the number of bristles in a particular region, the number of pigmented eye facets, etc.; in plants, they may be modifications in leaf or petal structure, change in color pattern, and the like. In higher forms, including man, characteristics such as complexion, stature, mental capacity, etc., are known to be hereditary and controlled completely or in part by chromosomes. Experiments have demonstrated that various hereditary patterns in higher forms (rats and mice) can likewise be modified by exposure of mature germ cells to radiation—presumably through alteration of the chromatin material. When such chromosome changes lead to modification of vital organs in development and death results prematurely, they are called "lethal mutations." Actually, chromosome alterations have been observed in lower forms which lead to

death before the organisms are old enough to be used in breeding tests but, because of the similarity of the chromosome changes involved, they are presumed to be lethal mutations in the same sense. All chromosome modifications, which presumably can be shown to be inheritable if breeding tests could be carried out, are regarded as genetic.

Irradiation of sea urchin sperm or ova before fertilization often leads to multipolar cleavage at the time of the first mitotic division of the zygote. After such changes, several subsequent divisions may occur in the cell progeny, but usually death of the new organism occurs very soon. In other embryos of the same samples, abnormalities do not show until later in development. Depending on which cell group is involved, the abnormality may result in death or various degrees of monster formation. In *Drosophila*, irradiation of mature sperm in the male and of mature ova in the female leads to similar changes after fertilization. Treatment of frog gametes likewise leads to the most bizarre development. In some embryos, excessive proliferation takes place with almost no differentiation; in others, differentiation occurs but it is extremely abnormal. In mammals, exposure of male or female mice or rats before conception has also led to abnormalities. When the developmental changes take place early in the higher forms and are of the lethal variety, usually resorption occurs and the

only effect seen is smaller litters. When changes occur late, abnormalities may be seen in the offspring. In these types of injury, it is safe to presume that many—perhaps indeed a large portion—of the changes induced resulted from chromosome modifications.

From our general understanding of heredity it is known that some mutations are inherited as dominants and others as recessives. Thus, recessive abnormalities may be masked by the dominant and not be revealed for many generations, or at least until two recessive mutant genes come together in the same offspring. Through an accumulation of such recessive mutant genes in the population, it is conceivable that irradiation changes may become more prominently revealed in future generations. Whether gene and chromosome changes and developmental abnormalities are produced in human beings the same as in other forms is as yet not satisfactorily demonstrated. However, because of the universal similarity of the hereditary mechanism in organisms generally, and the similarity of the action of radiation in the cases studied, it seems likely that changes are being produced in exposed human beings the same as in other forms.

The chief problem, then, is one of determining whether the present permissible exposure level (0.1 r per day) contributes unfavorably to the genetic well-being of the human race.

The Question of Threshold: The concept of tolerance, as usually applied, implies that there are levels of irradiation exposure below which injury will not be produced. For effects such as skin erythema, sterility, and lowered leukocyte level, significant amounts of radiation can be administered before changes will begin to be manifested. With regard to this type of change, one can speak with justification of threshold doses and think in terms of safe levels.

For changes such as the production of mutations (in *Drosophila* and various plant forms) and the killing of microorganisms (bacteria, viruses) there appear to be no threshold levels of dose as de-

termined by actual experiment. The frequency of occurrence starts from zero dosage, rising rapidly at first but diminishing as the amount of affected material is reduced. These effects are all-or-none in character and appear to result from single atomic or molecular changes induced by radiation. In such instances one cannot speak of threshold doses or tolerance levels, as they do not exist. As soon as the dosage exceeds zero, there are certain chances that any particular cell will be affected. The greater the dose, the greater the frequency of cell change.

Mutation Rates: It has been shown that for a particular mutation in *Drosophila*, the normal spontaneous rate of occurrence is practically doubled by doses in the neighborhood of 30 r. Since the normal spontaneous rate for this mutation is approximately 1 in 1,000 (1 out of every 1,000 cells showing the effect), this means that the frequency, instead of being 1 in 1,000 as normally, is raised to 2 in 1,000 by doses of 30 r (approximately the exposure for one year at 0.1 r per day).

Assuming for the moment that the action of radiation in human beings might be the same as in *Drosophila*, the thought of having the chances of abnormal offspring increased from 1 in 1,000 to 2 in 1,000 does not appear to be so great a hazard and probably would not deter prospective parents in accepting exposure when occupationally necessary. The figures just given, however, pertain to only one kind of mutation (in *Drosophila*), when actually there are many kinds, any or all of which may have far-reaching biologic consequences. The possibility of producing some kind of mutation, then, even with small radiation doses, appears considerably greater.

Irradiation-Induced Mutations in Human Beings: With the possibility of irradiation-induced mutations appearing so likely, why are abnormalities not seen more often in the offspring of individuals exposed to radiation? Two possible explanations will be offered here and others will become apparent later. First, irradiation-induced

mutations result in changes which are often identical with changes which arise spontaneously, making the detection of abnormalities resulting from exposure to radiation dependent upon statistical evaluations. Some statistical studies have been made but, although a small amount of positive evidence has been obtained, the data are so limited they have little meaning. Second, many mutations are recessive in character and, since the possibility of two similar mutant genes coming together in the same individual is very remote at first, the process of production of such genes must be in operation a long time before recessive characters can be manifested in appreciable numbers.

Evolutionary Aspects: In a system as delicately balanced as the living cell, it is obvious that radiant energy for the most part would have disorganizing or deleterious effects. Since such deleterious effects may become fastened on the germ line in the form of mutations, they may contribute to a growing racial weakness. This possibility has caused some to express concern over the fate of future generations and urge that prospective parents should avoid exposure to ionizing radiations completely. As we now know, however, this is impossible, as all living things through succeeding generations have been exposed to earth and cosmic radiations at the rate of approximately 0.001 r per 24-hour day. It is a fair question then to ask whether the trend in the past has been toward racial weakness and whether stepping up the exposure by a factor of 100 (i.e., to 0.1 r per day) would be unfavorable racially.

There seems little question but that high-energy radiation in any amount will contribute to a greater frequency of abnormalities in first-generation offspring. On this point most investigators agree. Attitudes differ, however, concerning the possibility of mounting racial weakness. While evidence is available from *Drosophila* showing that the number of irradiation-induced mutations is accumulative in succeeding generations, it would appear

that through the forces of nature (natural selection and survival of the fittest) the unfavorable features are not retained. Indeed, there is available a small amount of evidence, also from *Drosophila*, indicating that certain types of injured germ cells are unable to complete the process of maturation and are thus prevented from passing on the abnormalities. Just how completely irradiation changes are removed from the germ line by natural forces has yet to be demonstrated.

Implications: It is plain from the brief dissertation presented here that the attitudes taken at this time toward irradiation of the germ line may have far-reaching biologic consequences. It is plain, also, that some exposure of the germ line will occur despite all that man may do to prevent it. Whether 0.1 r per day will add appreciably to the hazards of life is as yet not known. However, in view of the fact that exposed sperm or ova of many species are known to pass abnormalities to offspring, it would seem not ill-advised to assume that exposure of the germ line should be kept at a low level. Only further experience will make it clear whether we wish to tolerate the injury caused by 0.1 r per day.

The suggestions arising from the present considerations have still further significance. As yet the process of lethal mutations has not been eliminated as the mechanism whereby the cellular elements (lymphoid and myeloid cells and germinal epithelium of the skin and gonads, etc.) of higher forms are destroyed. It is not improbable that cells such as lymphocytes are killed by the single-hit mechanism, the same as bacteria or viruses, and that the present so-called "tolerance" exposures represent the regenerative capacity of the cellular reserve of a particular tissue. In such a case, injury to the host organism would be seen only when the rate of destruction of cells exceeds the rate of production or the ability of the organism to compensate fully.

At this time it is important to keep in mind:

1. That for a certain type of cell killing there may be no threshold level of exposure but that, for certain types of injury in the mammalian organism, subthreshold or subliminal exposures may exist.
2. That subliminal effects, present over a period of years, may be important factors in later life, especially in long-lived forms.
3. That in last analysis it may be more correct to speak in terms of "tolerance injury," that is, the amount of injury an organism can tolerate without complication, rather than "tolerance dose."

Human Factors

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One of the commonest causes of radiation injuries to the hands of a physician is the manipulation of fractures during fluoroscopy. The chance of such injury is minimized where the orthopedist is working in co-operation with a radiologist who knows the dangers and insists on discontinuation before the tolerance dose is reached. Many orthopedists and general practitioners, however, own or have access to a fluoroscope and use it daily without regard for damage until too late. Many of the older fluoroscopes, because the tube is closer to the table top than in the newer instruments, put out an excessive amount of radiation. The aluminum filter so necessary to stop the less penetrating rays, which are of no value in the production of the visual image but have strong biological effect, is in many cases omitted. Having a machine tested by one competent to do this work will greatly reduce the hazard. Finally, there is no need for the orthopedist to expose his hands, because he can easily learn to do the manipulations, then look, with his hands out of the field.

One feature which is grossly neglected by most inexperienced fluoroscopists is proper eye accommodation. Most of them feel that their time is too valuable to spend in subdued light and that the wearing of accommodation goggles is too much trouble. Any person who feels that he can see the fluoroscopic image without long eye rest under very subdued light of the correct quality is simply fooling himself.

Unfortunately, the inexperienced fluoroscopist, in attempting to see the screen as soon as he goes into the fluoroscopic room and finding the image of low visibility, will increase the milliamperage on the tube instead of waiting for his eyes to accommodate. Regardless of all that has been said and can be said, this necessity is still a matter of common disbelief among those who have not had extensive training with the fluoroscope.

The removal of foreign bodies under fluoroscopy is extremely hazardous. Needless to say, the above-mentioned precautions about having a reasonably safe machine should be observed. Frequently the operator becomes so absorbed in his task that he loses all idea of time until a desperately heavy dose has been given to his fingers or to the patient. Here again, as in the previously mentioned case, proper eye accommodation is vitally important.

If all of the above work is done with a correctly designed fluoroscope, the chances of injury are minimized. Unfortunately, much of this work is done not with such equipment but with a portable machine which has no spacing arrangement of any kind to prevent the skin of the patient from being placed within a very few inches of the tube. Of course, in this case, an enormously greater dose is given to the skin than in the instance where a tube on the fluoroscope is 14 to 20 inches below or behind the table top. It is a common

human failing to regard the small portable machine as so innocent looking that it is incapable of doing much damage.

The fluoroscope or, as far as that goes, any x-ray machine, should never be used as a toy or as a means of entertainment. There are many cases on record where inexperienced operators in demonstrating fluoroscopic images to their friends or to interested patients have caused serious damage.

A lead-rubber apron should, at all times, be worn by one who operates the fluoroscope and by those who are in continuous attendance close to the machine. A person who does this work should make it a definite rule never to place his hands in the beam unless he is wearing lead-rubber gloves. Other protective materials such as lead-glass goggles or head masks are unnecessary and, in most cases, such a nuisance that they prevent good work being

done. The present type of fluoroscope does not, as a rule, need any added protection such as a lead frame around the fluoroscopic screen, although some careful operators prefer to have them.

Much discussion has taken place about the practicability of the manufacturers placing a label on their machines as to the safe limits of operation, but one who is familiar with the subject realizes full well that no label could be written which would cover all the circumstances, and that there is no x-ray machine which is biologically safe if improperly used.

The manufacturers have done an excellent job in making modern equipment electrically safe, and the best possible job in making it safe from the point of view of radiation, but no one yet has built a machine which is fool-proof. In this work, as in any other work, there is no substitute for common sense.

X-Ray Protection in Industrial Fluoroscopy

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X-ray protection in industrial fluoroscopy involves problems somewhat different from those of protection in radiography. In the first place, for an object which is thin enough for fluoroscopy, higher voltages are generally employed on a fluoroscope than for a film. This is because the fluoroscope does not have the property of integrating or accumulating the x-ray effect as does the film. The screen fluoresces according to the instantaneous energy which it receives and, therefore, a higher instantaneous energy is required. From the point of view of load on the x-ray tube, the screen brightness is most efficiently increased by raising the voltage applied to the tube. This tube voltage has been raised to 220 kv. in some industrial fluoroscopes. Tubes which can be operated at much higher voltage than this are available, but to use them for fluoroscopy introduces a protection problem out of proportion to the gain in

visibility obtained. For this reason, the practical limit in tube voltage in industrial fluoroscopy is about 250 kv., while in radiography 2,000 kv. may be employed. At a given kilovoltage the protection problem in fluoroscopy is more formidable than in radiography because the x-ray tube is operating for a much longer total period of time and, even though it may be at a lower tube current, the total amount of x-rays generated is usually much greater. Furthermore, the fluoroscopist is apt to be much closer to the tube than the radiographer.

The hazards of industrial fluoroscopy may be considered from the point of view of (a) the fluoroscope operator and (b) the other people who work near the fluoroscope. The x-ray protective material must be applied so as to absorb sufficiently (a) the direct x-ray beam, and (b) the scattered or secondary x-rays.

The direct x-ray beam should be effec-

tively blocked off by using a sufficient thickness of absorbing material, preferably lead, around the x-ray tube itself and in the fluoroscope housing. That part of the direct x-ray beam striking the fluoroscopic screen has to be absorbed by a sufficient thickness of lead-glass. The thickness of lead, and lead-equivalent thickness of lead-glass, to protect from the direct x-ray beam at various kilovoltages and tube currents will be found elsewhere in this report. It is essential in providing for protection against the direct x-ray beam that no leaks occur in the construction of the unit. Methods of testing for leaks will be described below.

It cannot be too strongly stressed that the hands of the fluoroscope operator must never be allowed to enter the direct x-ray beam. This might be done in adjusting the position of a specimen while its fluoroscopic image is being observed. This is usually prevented by having a safety switch on the fluoroscopic cabinet which automatically turns off the x-ray when the cover is opened. Such a safety device should be placed on every industrial fluoroscope where the operator could possibly get the hands in the direct x-ray beam. The lead-glass over the fluoroscopic screen protects the operator's face from the direct x-ray beam. Care should be exercised that the lead-glass covers the beam under all possible circumstances. If any adjustments of the x-ray tube are made, or if a new tube is installed, this should be carefully checked again.

Scattered x-rays are less penetrating than the direct beam but they have to be separately considered because they are emitted in all directions wherever x-rays penetrate matter. In industrial fluoroscopy, scattering comes principally from the castings or specimens being examined. This is an added problem because sometimes one end of a long casting which is being examined may project from the fluoroscope housing, thus possibly allowing the escape of scattered x-rays. Should the operator or an assistant hold or manipulate the casting during fluoroscopy,

there is the possibility of excessive exposure of the hands and other parts of the body to scattered radiation. Fluoroscope housings or enclosures may also be open in some types of systems where the specimens are brought to the fluoroscope on a conveyor belt. In this case, scattered x-rays can escape through the entrance and exit openings. Baffles should be provided to intercept the scattered rays or care should be taken to see that no individual is allowed to be in the zone of scattering for an appreciable period of time. Such imperfections can usually be overcome by proper layout of the conveyor and fluoroscope. Conveyor systems in which the specimens are brought vertically up to the fluoroscope, then horizontally across it for the examination, and finally leave it by moving vertically down can be more easily and more thoroughly shielded from scattered radiation. In nearly all cases of industrial fluoroscopy it has been found possible to do a very thorough job of installing x-ray protection so that there can be no possible serious injury to the fluoroscope operators or surrounding personnel. With proper installations and good methods of testing for leaks, an industrial organization will be protected in case of any future law suits.

METHODS OF TESTING X-RAY PROTECTION OF FLUOROSCOPES

The Geiger-Müller counter offers an extremely rapid, sensitive, and convenient method of checking the x-ray protection of any fluoroscope. The instrument can be made in a handy form to carry around the fluoroscope or to test any suspected location. The counter is usually operated from a 110-volt A.C. line and is furnished with head phones giving an audible signal when the sensitive counter tube is traversed by x-rays (or gamma rays of radium). An ordinary-sized counter tube may have a sensitive volume whose cross section is 1 cm. by 3 cm. This is sufficiently sensitive for this type of work, since it will give a background count (from cosmic radiation exclusive of possible

radioactive contamination in building materials or of radium being used in nearby locations) of about 8 counts per minute. It is thus capable of detecting stray radiation within the intensity range of cosmic radiation. Such a highly sensitive instrument is not a drawback, because it is possible in practice to build a closed industrial fluoroscope with sufficient x-ray protective material so that the counting tube may be placed in any position around it and the clicks in the head phones can easily be counted by ear.

With a Geiger-Müller counter of the size mentioned above, working on the plateau of its voltage curve (that is in the most sensitive part of its stable range), giving clicks at a rate which can readily be counted, the tube will be in an x-ray field having an intensity which is many times below that of the tolerance exposure intensity. Therefore, if a fluoroscope is examined while it is in operation with such an instrument and nowhere are clicks heard more rapid than can be counted, the x-ray protection can be confidently said to be sufficient. It is, of course, necessary to know that the counter is operating correctly and that every location in which a person may be has been thoroughly covered. In using the Geiger-Müller counter equipment, the fluoroscope is examined while it is in routine operation. By moving the sensitive tube around the housing, while listening with the ear phones, one may detect any x-ray leak immediately as a sudden burst of clicks. By moving the tube around, the exact location of the leak (such as a nail hole or crack) can be located. The adequacy of the lead-glass covering the fluoroscopic screen may also be tested. When any change is made in the fluoroscope, the x-ray protection should again be checked. The answer can be obtained in a few minutes by this method.

Another method of testing for leaks or scattered radiation from an industrial fluoroscope makes use of x-ray film. The areas to be tested are covered with an x-ray film, which is placed in a light-tight en-

velope. After the machine has been operated for a few hours, the film is taken to the dark room and developed. If there is an appreciable x-ray leak the film will be blackened over that area. The same principle is employed in testing for x-ray exposure of any member of the personnel. A dental type film is fastened to the wrist or chest. The side marked "tube side" must be facing out and it can be covered with a paper clip to aid in analyzing the film later. The film is worn in this way at all times that the individual is at work. After two days the film is removed and developed. If it is fogged sufficiently so that the shadow of the paper clip is visible the situation should be further investigated and more x-ray protective material added so as to absorb the radiation leaking out from the fluoroscope.

It is also possible to test for small amounts of stray x-rays with a highly sensitive ionization chamber. Such a chamber with its charging equipment and measuring string electrometer is now on the market (Victoreen "minometer"). The chamber, which is about the size of a fountain pen, is electrically charged to a certain degree, as indicated on the electrometer. It is then worn for a working day in a vest pocket of the person being tested. The chamber is returned and immediately connected to the electrometer, which indicates the degree of discharge from x-ray exposure in terms of roentgens. The chamber may also be placed in suspected positions around the fluoroscope, and x-ray leaks will be indicated by various degrees of discharge as shown by the electrometer.

Another precaution that can be observed in checking an overexposure to x-rays is to take periodic blood counts on all persons who might be exposed to x-rays. By taking these counts at about two-month intervals, a base line can be established for each individual. Then, if a large proportion of the worker's body has been exposed to an excessive amount of x-rays, the damage will be reflected in the blood count, principally by a drop in the white

cell count and a rise in the reticulocyte count. Such counts must be interpreted by a physician familiar with the effects, because even in a normal person the count may vary quite widely from time to time. It is important to realize that a periodic blood check is of value in estimating damage from whole body irradiation. A local-

ized devastating exposure of x-rays could be administered to a hand or foot without appreciably affecting the blood count. Furthermore, by the time the blood count has been affected enough to indicate an excessive x-ray exposure, considerable damage may already have been done to the body.

Materials and Methods of X-Ray Protection

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The object in planning x-ray protection for any installation is to reduce the x-ray intensity at all positions where personnel will be stationed to a value such that no one will receive more than 0.1 r during any 24-hour period. No hard and fast rules need be laid down for accomplishing this; the methods to be used are best left to the ingenuity of those making the plans. Almost any space can be made safe against x-rays by the use of lead or concrete walls of sufficient thickness, though in practice such an installation would probably be considered prohibitively expensive, especially when protection against very penetrating radiation is required. The alternative is to consider other methods of protection to be used in addition to radiation barriers. In the interest of economy, full consideration should therefore be given to all three of the following factors: (1) distance from barrier to x-ray source; (2) direction of x-ray beam; (3) radiation barriers.

Distance from Barrier to X-Ray Source: The intensity of any beam of x-rays falls off inversely as the square of the distance from the x-ray tube target. This holds true for all x-radiation regardless of its penetrating power. For example, a twofold increase in distance from the tube target results in a fourfold decrease in the x-ray intensity; a tenfold increase in distance reduces the intensity to 1.0 per cent of its initial value. By making the dis-

tance from the x-ray source to all operating stations as great as possible, a saving can be effected in the cost of lead sheet, concrete, or lead-glass. Such savings increase rapidly as the penetrating power of the radiation goes up, for then progressively thicker barriers are required to reduce a given beam to, let us say, 1.0 per cent of its initial value. Regardless of what the radiation quality may be, however, the same percentage reduction can be brought about by increasing the distance tenfold.

For reasons of economy, first consideration should, therefore, be given to the matter of distance between the x-ray source and all occupied spaces in the immediate vicinity. The x-ray room should be as far removed as conditions will permit from all offices, laboratories, and shops where workers remain throughout the working day. Where occupied rooms must be near the x-ray space, it is good practice to place them on opposite sides of a corridor. Inside the x-ray room, the tube should be placed as far away as possible from all operators, consideration being given to the use for which the radiation is intended and to the space available for the purpose. In neither medical nor industrial x-ray rooms can full advantage be taken of the saving possible through increasing the distance from the x-ray source; it may be necessary to watch a patient during treatment or to palpate a patient during a fluoroscopic examination;

in industrial radiography and fluoroscopy within protected cabinets, the presence of nearby operators may be essential. In any case, all persons concerned with the operation of an x-ray installation should understand clearly that the first defense against any radiation hazard is distance. The safe thing to do is to "stay away."

common use, are designed to reduce the radiation intensity transmitted by any part of the housing—other than the exit port—to about 1.0 per cent of that of the useful beam. It must not be assumed that this is always so; many tube casings have insufficient protection, especially at the cathode end. Nevertheless, by

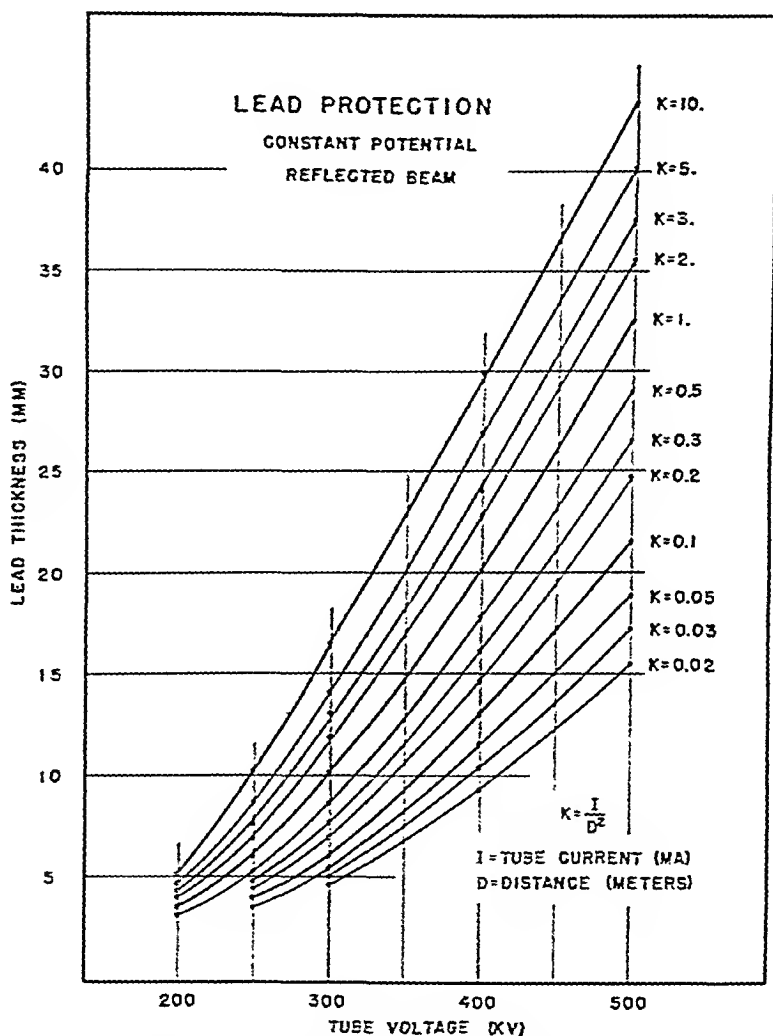


Fig. 1. Lead thickness required for protection against narrow x-ray beams generated by voltages between 200 and 500 kv. for various distances between the tube target and operator.

Direction of X-Ray Beam: The second consideration in planning x-ray protection should be the direction of the x-ray beam. Wherever possible, the main beam should be directed away from occupied areas, preferably toward the ground or an outside wall remote from adjacent buildings or yards where men may be at work. So-called "ray-proof" tube housings, now in

recting the exit port away from all occupied spaces nearby, full use is made of such protection as has been built into the tube housing by the manufacturer. The problem is thereby simplified; protection remains to be provided only against the direct radiation not absorbed by the tube casing and the radiation scattered out of the main beam by the air and by irradiated

objects. The thickness of lead provided by the tube housing may be subtracted from the total required to afford adequate protection, but only in those directions in which the shielding action of the case is known to be effective and for which sufficient protection against scattered radiation has been provided.

Radiation Barriers: When full advantage has been taken of both distance and tube orientation, it will usually be found that the radiation intensity is still excessive at the control station and in adjacent rooms. Thought must then be given to protective walls or screens. For x-rays generated by voltages under 250 kv., lead

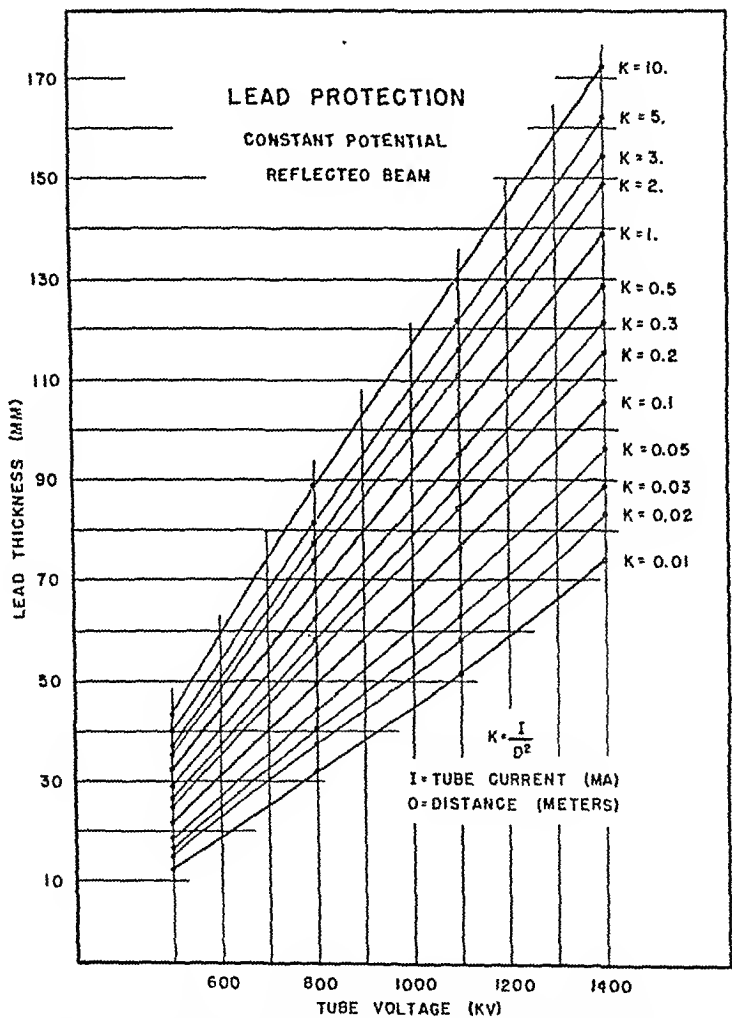


Fig. 2. Lead thickness required for protection against narrow x-ray beams generated by voltages between 500 and 1,400 kv. for various distances between the tube target and operator.

For many applications, it is essential that the x-ray tube head be left free to rotate into any desired position; then one has no choice but to provide protection against the full intensity of the useful beam by increasing the distance to all nearby occupied spaces, by interposing protective barriers of adequate thickness, or by a combination of both methods.

sheet is generally used for this purpose; for more penetrating radiation, concrete is most often chosen. The use of lead sheet in combination with concrete is becoming more common and has much to recommend it. The type of barrier selected is determined by relative cost and convenience.

Two classes of protective barriers should

be distinguished: (1) barriers against direct radiation—from the tube port, from leaks in the tube housing, and from radiation not absorbed by the tube housing; (2) barriers against scattered radiation—scattered by the patient, walls of the room, or other irradiated objects. The scattered radiation is generally less penetrating and less intense than the direct radiation; less protection is, therefore, needed against it.

From curves given in Figures 1 and 2, it is possible to compute the thickness of the lead barriers necessary for shielding against direct x-radiation generated by constant potentials between 200 and 1,400 kv. The data needed for making this computation are: (1) the tube current, (2) tube voltage, and (3) the distance. The computation is made as follows:

A. Find K by dividing the tube current in milliamperes by the square of the distance to the tube target in meters, thus:

$$K = \frac{I}{D^2}$$

where I = tube current in milliamperes and D = distance in meters from target to nearest person.

For example, if the nearest person is 3 meters from a tube passing a current of 3 ma. at 1,000 kv.,

$$K = \frac{3}{(3)^2} = \frac{3}{9} = 0.33$$

B. Select the curve in Figure 1 or 2 having the value of K computed as shown above. If this value of K is not given, it may be necessary to interpolate between curves. Beginning at the extreme right, follow this curve down to the point where it cuts the vertical line corresponding to the tube voltage used. Read at the extreme left the lead thickness to which this point corresponds.

Thus, in the example given above, having found $K = 0.33$, we select the curve in Figure 2 marked $K = 0.3$, because it is nearest to our computed value. Following this curve down to the point where it intersects the vertical line for 1,000 kv., we read off the required lead thickness—at the left margin of the chart—as 78 mm. or 3.1 inches.

By an identical procedure the concrete required for protection against direct x-radiation can be computed from Figures 3 and 4.

The procedure outlined above for computing K should be followed in all cases where no information is available as to the intensity of the useful beam. When this datum is given, a more exact estimate of protection is possible by taking this information into consideration. The curves in Figures 1–4, inclusive, were computed on the assumption that the x-ray tube output at various voltages is approximately that given in Table I.

TABLE I: X-RAY TUBE OUTPUT ASSUMED IN FIGURES 1–4

Tube Voltage (kv.)	Tube Output (r/minute ma. at 1 meter)
200	1
400	5
600	10
800	20
1,000	30
1,200	50
1,400	70

When the radiation intensity at a meter is known for any of the voltages listed in Table I, the value of K , as computed above, should be multiplied by the ratio of the known output of the tube at this voltage to that given in Table I for the same voltage. A new value of K is then obtained—it will generally be smaller than the original—from which the lead barrier required is found by following the instructions given above under B.

By way of example, suppose that in the case already cited, the tube output is known to be 15 r per minute milliamperes at a distance of one meter. For 1,000 kv. the output assumed in Table I is given as 30 r per minute milliamperes at one meter. The value of K already computed (0.33) should, therefore, be multiplied by the ratio 15/30, giving:

$$K = 0.33 \times \frac{15}{30} = 0.17$$

With the new value of K , a more exact estimate of the required lead or concrete can be obtained by following the procedure outlined under B. These values turn out to be 71 mm. or 2.8 inches of lead and 50 cm. or 19.7 inches of concrete.

Figures 3 and 4 are for concrete weighing 137 pounds per cubic foot (specific gravity 2.2). For other concrete mixes the thickness required varies inversely as the specific gravity or weight of the material per cubic foot. For example, let the thickness of concrete weighing 160 pounds per cubic foot be required. If from Figure 3 a con-

crete thickness of 50 cm. is found, then the thickness for the 160-pound concrete is computed as follows:

$$50 \text{ cm.} \times \frac{137}{160} = 43 \text{ cm.} = 17 \text{ inches}$$

Like concrete, such materials as brick, plaster, earth, water, etc., afford some degree of protection against x-rays and may

be used either in place of lead barriers or in combination with them. At voltages above 200 kv., concrete, brick, and earth are frequently used without sheet lead. The combination of such materials with lead is, however, to be recommended wherever practicable, for several reasons. In the first place, there is always the pos-

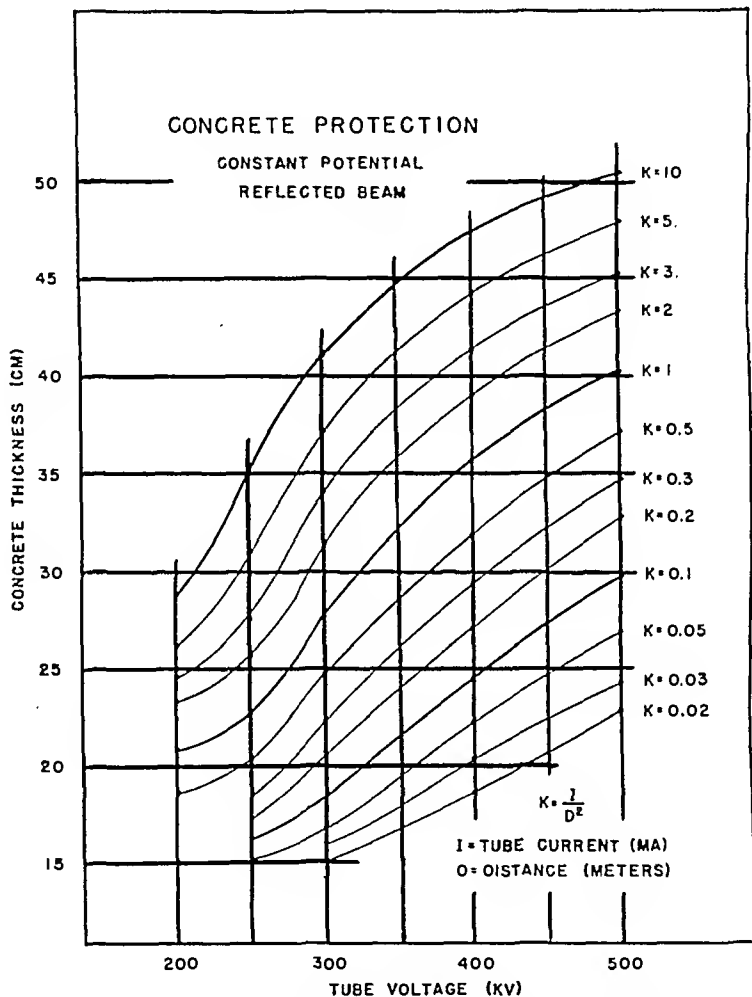


Fig. 3. Concrete thickness required for protection against narrow x-ray beams generated by voltages between 200 and 500 kv. for various distances between the tube target and operator.

creteness that cracks may develop in thick non-metallic walls; the addition of sheet lead to such walls reduces the radiation hazards should such cracks develop. Furthermore, relatively light barrier materials attenuate an x-ray beam by scattering, a process which involves, (a) the deflection of the radiation from its original path and (b) a reduction in its penetrating

power. Some scattering takes place in all materials and for all qualities of radiation, but this effect is more pronounced in relatively light materials and for very penetrating radiation. So, for example, scattering is greater for concrete than for lead and is greater for penetrating radiation than for relatively soft x-rays. From

radiation is incident. Another advantage—but a secondary one—resulting from the use of such a lead “veneer” is that, on passing through it, the radiation is thereby hardened and, since concrete is relatively more effective for hard radiation than for soft, the concrete portion of the barrier becomes relatively more effective.

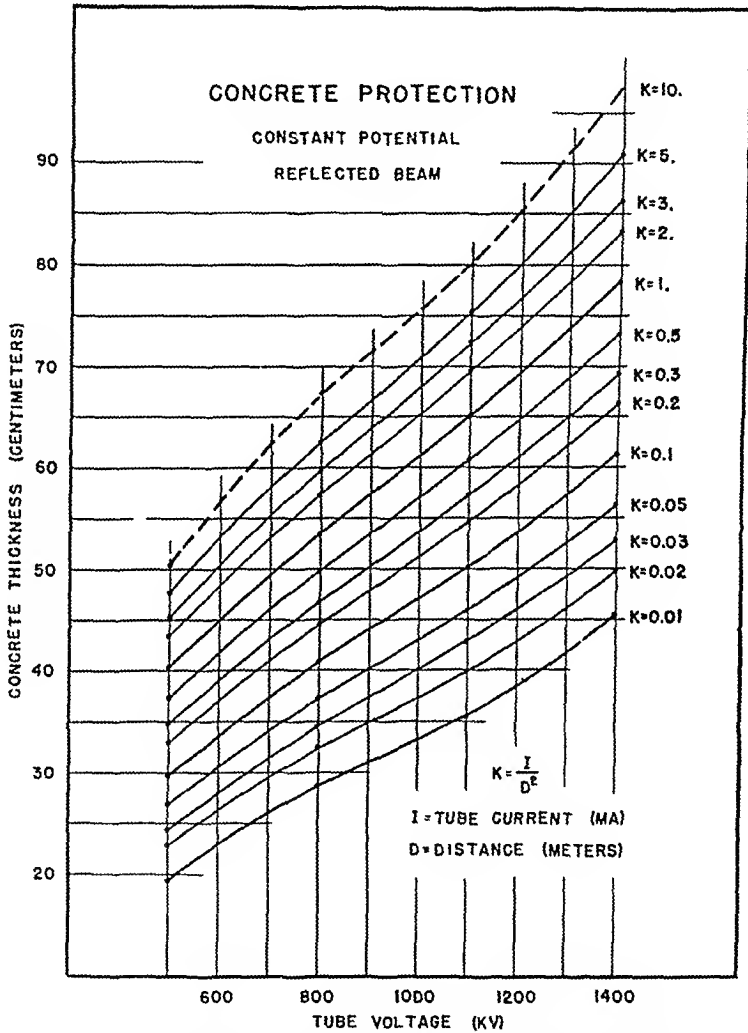


Fig. 4. Concrete thickness required for protection against narrow x-ray beams generated by voltages between 500 and 1,400 kv. for various distances between the tube target and operator.

the point of view of x-ray protection, scattering is undesirable; when scattering occurs, a part of the x-radiation incident upon a barrier is scattered back upon persons within the protected space. The effect of back-scattering from concrete or brick walls can be reduced by adding a relatively thin layer of lead to the side of the protective barrier upon which the

Scattering also results in undesirable effects on the emergent side of concrete protective barriers. Radiation that penetrates barriers made of relatively light materials is less penetrating than the incident radiations. The addition of sheet lead on the far side of concrete barriers, therefore, effectively serves the purpose of absorbing the radiation which has pene-

trated the barrier and has been degraded in the process.

Effect of Beam Width on Relative Thickness of Concrete and Lead Required for Adequate Protection: In the foregoing paragraphs it has been assumed that the diameter of the x-ray beam against which protection is required is relatively small, of the order of 2 to 5 cm. In practice, x-ray beams as narrow as this are seldom used; this is true both in the medical and industrial applications of x-rays and is especially so in the latter field, where very broad beams are often used. Increasing the width of an x-ray beam makes it necessary to increase the thickness of the protective barriers beyond that required for adequate protection when narrow beams are used. This necessary increase in barrier thickness is not the same for all materials, being relatively greater for light materials such as concrete and brick, than for lead. Table II shows the ratio of the thickness of concrete to the thickness of lead required to reduce the incident radiation to the same extent—to a level of approximately 10^{-5} r/sec.—on the emergent side of the barrier. This table holds only for very narrow beams of x-radiation, of the order of a few centimeters in diameter.

TABLE II: RATIO OF THICKNESS OF CONCRETE TO THICKNESS OF LEAD REQUIRED FOR EQUIVALENT PROTECTION

Kilovolts	Ratio Thickness concrete Thickness lead
75.....	74
85.....	67
90.....	65
100.....	60
110.....	63
115.....	65
120.....	67
125.....	68
150.....	72
160.....	74
200.....	55
250.....	34
300.....	25
400.....	16
500.....	12
600.....	9.3
700.....	8.1
800.....	7.1
900.....	6.5
1,000.....	6.1
1,200.....	5.6
1,400.....	5.2

The effect of increasing the diameter of an x-ray beam is to increase the ratio given in the second column of Table II. To say the same thing in another way, as the beam diameter is increased the percentage increase in the thickness of a concrete barrier must be greater than the corresponding increase in a lead barrier if the x-ray protection of both is to remain the same. This fact should be kept in mind when the data given herein are used, since narrow beams have been assumed throughout this discussion. In making use of these data, the barrier thickness used should be greater than that recommended if the use of broad beams is contemplated. Exact information on the increase required when broad beams are used is not now available because of the technical difficulties involved in obtaining such information. The following is offered as a suggestion: that, when broad beams are used, the thickness of the barrier in question be increased by one half-value layer of the barrier material used for voltages up to 500 kv.; that for voltages between 500 and 1,000 kv., the barrier thickness be increased by two half-value layers; and for voltages between 1,000 and 1,500 kv., by three half-value layers.

Protection from scattered radiation should not be overlooked. A barrier between the x-ray tube and employees to protect them from the direct rays may not shield them from rays scattered by walls, ceiling, furniture, and other objects. This might happen, for example, in a one-story foundry building where a concrete barrier 7 feet high has been erected to stop the direct beam from the x-ray tube. If the unobstructed beam is directed toward the roof structure above the barrier, a part of the radiation will be scattered by the roof to reach the employees outside the barrier. This can be prevented by extending the barrier to the roof. The upper part, which need absorb only the scattered rays, can be much lighter than the lower part that must absorb the primary rays.

The intensity of scattered radiation reaching personnel will depend on many

TABLE III: PROTECTION AGAINST SCATTERED RADIATION

(Thickness of lead in inches required for protection against scattered radiation. Tube operated at 10 ma.)

Kv.	Scattered Rays			Rescattered Rays			Safe Distance No Shield
	3'	10'	20'	3'	10'	20'	
50	0.01	0.01	..	..	..	..	3'
75	0.02	0.01	..	0.01	..	..	4'
100	0.03	0.01	..	0.01	..	..	5'
140	0.05	0.01	0.01	0.03	..	..	7'
200	0.08	0.03	0.01	0.04	..	..	10'
250	0.12	0.05	0.02	0.05	0.01	..	15'
300	0.16	0.07	0.04	0.06	0.01	..	20'
400	0.22	0.15	0.08	0.07	0.01	0.01	25'
500	0.28	0.22	0.15	0.09	0.02	0.01	28'
600	0.35	0.30	0.20	0.11	0.03	0.01	33'
800	0.5	0.4	0.3	0.13	0.04	0.01	35'
1,000	0.6	0.5	0.4	0.15	0.05	0.02	....
1,400	0.6	0.6	0.5	0.17	0.06	0.02	....
2,000	0.7	0.7	0.6	0.20	0.07	0.03	....

factors, including the nature of the surface and the distances and directions that the rays must travel, as well as the kilovoltage and milliamperage of the source. It will always be weaker than the primary or direct radiation. It will also be less penetrating, particularly when high-kilovoltage apparatus is used. Lead is usually more economical and convenient than masonry or concrete for protection against scattered radiation only, and the thicknesses required are relatively small. Recommended thicknesses are tabulated in Table III for various kilovoltages of the apparatus and distances of the exposed scattering surface from the employees. In compiling this table, extremely unfavorable conditions were assumed, *e.g.*, that the scattering surface was close to the x-ray tube and of a material that scatters efficiently.

The distinction between singly scattered radiation and multiply scattered radiation is important. In the example above, of the tube behind a barrier 7 feet high, the rotation of the tube might be so restricted that the direct beam could not be pointed

at the roof and hence it might not be possible for rays to get over the barrier without being scattered at least twice, for example, by both floor and roof. Doubtless scattered radiation would be both weaker and less penetrating than singly scattered radiation, and, therefore, would require less lead to absorb it. The recommended thicknesses for multiple scattering are given in Table III under the heading "Rescattered Rays." The final column gives the closest distance of safe approach to a wall emitting rescattered radiation when no protection intervenes.

The intensity of scattered radiation depends considerably on the material of the scattering surface. Ordinary structural materials like masonry, concrete, plaster, and wood scatter much more radiation than heavy metals like lead. For this reason it is desirable to cover all such surfaces likely to be exposed to direct radiation with lead. A thickness of 1/8 inch is suitable and sufficient for this purpose. Even 1/16-inch lead over a masonry wall gives considerable improvement.

EDITORIAL

Lowell S. Goin, M.D.

President of the Radiological Society of North America

The Radiological Society of North America would seem to have been most wisely guided that it has chosen Lowell Goin for its President exactly at this time, when the social and economic structure of medical practice is suffering critical strains. Rupture of the fabric seems imminent, even total solution, out of which must crystallize the pattern for the future. How it will recrystallize depends largely on the men we choose to guide us. Lowell Goin has long been active in the affairs of his fellow physicians, a calm representative of their best interests; when the political waters were smooth, a pleasant friendly island; when the political storms blew hardest, a solid rock. Here is one man who seems comfortable in the chair with the gavel in his hand. This, I think, is not merely because he is a thorough parliamentarian, but also because he sees quickly and surely through every question to its ultimate implications. He is comfortable because he is rarely surprised.

Dr. Goin seems not to have bothered to send autobiographical notes to the various compendia, and I am indebted to John Crossan, his associate in medical practice, for most of the following data:

Lowell Sidney Goin was born in Charter Oak, Iowa, March 3, 1891, and received his education at the University of Iowa and St. Louis University, obtaining his M.D. degree in 1912, at the age of twenty-one. In 1915 he was already practising radiology and, when World War I came, he studied military radiology under George Johnson of Pittsburgh. He was made a captain in the Medical Corps and served a year and a half in France. Some of his personal experiences he has recorded in the

American Journal of Roentgenology (7 128-130, 1920). After the war, he was for two years with James T. Case at Battle Creek, before the latter accepted a call to Chicago. Then there was an interlude of graduate work under Holfelder in Frankfurt, followed by practice in Peoria.

In 1925 Dr. Goin went to Los Angeles and was associated with William B. Bowman. It was during this time that he published his first paper in *RADIOLOGY* (12: 188, 1929). I haven't counted the papers he has published there and elsewhere since. After Dr. Bowman's death in 1930, Dr. Goin formed a partnership with Dr. Crossan, an association that has prospered and endured.

In 1922 Dr. Goin married Margaret Morehead in Salem, Virginia. Their elder son was lost in action over Vienna in October 1944. The younger is a senior in the Army and Navy Academy, Carlsbad, Calif.

Lowell Goin was the first Chairman of the Pacific Roentgen Society, and he and L. Henry Garland have always been its backbone and its lifeblood, too; very largely responsible for the good work it has done in crusading for proper relationship of Radiology to Medicine and to Hospital Management. Closely linked with this were his activities on the Intersociety Committee. He has been active on the staff of Queen of the Angels Hospital, where he is radiologist, having twice been its President and for seven years past the Chairman of the Board.

For six years he was Speaker of the House of Delegates of the California Medical Association and last year was its President. At the same time he was President



LOWELL S. GOIN, M.D.
President, Radiological Society of North America

of the American College of Radiology. This was a year of great responsibilities, as he understood them and acted under them, especially in regard to the development of "health insurance." He has set forth some of his ideas in *California and Western Medicine* (62: 246-249, May 1945).

With all this he has found time and energy to keep his interest in music and was for a time on the Board of Directors of the Los Angeles Chamber Music Society. And I feel sure he never has, and never will, let down in his enthusiasm for good living, good talk, and good friends.

R. R. NEWELL



ANNOUNCEMENTS AND BOOK REVIEWS

CLEVELAND RADIOLOGICAL SOCIETY

The Cleveland Radiological Society co-operated with seven other interested groups in celebration of the fiftieth anniversary of the discovery of the roentgen ray. The other participating organizations were the Cleveland Medical Library, Academy of Medicine, Cleveland Dental Society, Western Reserve University, Case School of Applied Science, Cleveland Dermatological Society, and the Industrial Radium and X-ray Society.

Afternoon and evening sessions were held on Nov. 8 at the Cleveland Medical Library. Speakers at the afternoon session were Dr. Elmer Hutchisson on "Some Physical Aspects of the Roentgen Ray," Dr. Harry Hauser, on "The Roentgen Ray in Modern Medicine," Dr. Paul S. Sherwood on "The Roentgen Ray in Dentistry," and Dr. K. R. Van Horn on "Industrial Applications of the Roentgen Ray." The features of the evening session were the round table reminiscences of Dr. W. C. Hill, Dr. W. I. Le Fevre, and Dr. B. H. Nichols and an address on Wilhelm Conrad Röntgen by Dr. Otto Glasser.

An interesting exhibit was presented, illustrating the history and modern use of the x-ray, and this was open to the public on Nov. 11.

CANCER RESEARCH COMMITTEE ON GROWTH OF THE NATIONAL RESEARCH COUNCIL

As a result of action by the American Cancer Society designating the National Academy of Sciences as its scientific adviser for research, the National Research Council of the latter body has appointed a Committee on Growth, under the chairmanship of Dr. C. P. Rhoads.

The Committee announces the following major principles by which, so far as possible, it will be guided in its sponsorship of research and training programs:

(a) Desirability of long-term grants to projects of major importance.

(b) Grants, where possible, of such magnitude as to permit individual investigators to appoint associates for long-term training periods.

(c) Granting of fellowships to institutions for training of workers to acquire new techniques and wider experience.

(d) Maintenance of continuing individual contact with workers in field.

(e) Provision, on a participating basis, for continuing economic security for professional workers.

(f) Liberal attitude toward the investigator's work, his publication, and reports.

It proposes, furthermore, to arrange conferences of competent groups for discussion of problems, inter-

change of reports, etc.; to make surveys to analyze problems or to determine progress in areas of special interest pertaining to cancer; to evaluate through study by subcommittees and by the main committee, basic and clinical research undertakings; and submit recommendations for support to the American Cancer Society; to initiate and plan broad or specific programs of basic and clinical research, and to secure the co-operative efforts of investigators in the general undertakings.

The Committee has established a central office at the Washington headquarters of the Council (21 Constitution Ave., Washington 25, D. C.), where information on all phases of cancer research will be assembled and from which reports may be distributed to interested investigators.

THIRD ANNUAL WATTS HOSPITAL MEDICAL AND SURGICAL SYMPOSIUM

The Third Annual Watts Hospital Medical and Surgical Symposium will be observed Feb. 13 and 14, 1946, at Durham, N. C.

Clinico-Pathological Conferences will be held each day at 11 A.M. That on Wednesday will be conducted by Wm. B. Porter, M.D., and John S. Hooton, M.D., of the Medical College of Virginia; that on Thursday by Henry B. Mulholland, M.D., and James R. Cash, M.D., of the University of Virginia Medical School.

Among the speakers are W. C. Davison, M.D., Dean of Duke University Medical School, on "Postgraduate Medicine"; Lt. Col. Louis Kraus, Chief of Medicine, General Hospital, Camp Butner, N. C., on "Some Hemolytic Processes Including the Rh Factor"; Norris W. Vaux, M.D., Professor of Obstetrics, Jefferson Medical College, Philadelphia, on "The Treatment of Habitual Abortion"; Edward A. Strecker, M.D., Professor of Psychiatry, University of Pennsylvania Medical School, Philadelphia, on "Psychiatry Speaks to Democracy—About Mothers and Moms"; Arthur M. Shipley, M.D., Professor of Surgery, University of Maryland Medical School, on "Diverticulitis of the Colon"; James E. Paullin, M.D., Professor of Medicine, Emory University Medical School, Atlanta, Ga., on "The Relationship of Medical Practice to Gerontology"; Louis Hamman, M.D., Associate Professor of Medicine, Johns Hopkins Medical School, on "General Features of Periarthritis Nodosa, Particularly from the Standpoint of Diagnosis"; I. S. Ravdin, Professor of Surgery, University of Pennsylvania Medical School, on "The Pathologic Physiology of Biliary Tract Disease" and "The Surgical Aspects of Gallstone Disease"; Eugene P. Pendergrass, M.D., Professor of Radiology, University of Pennsylvania Medical School, on "The Roentgen Aspects of Biliary Tract Disease."

LEWIS GREGORY COLE, M.D. FRIEDENWALD MEDALIST

It is gratifying to record the presentation to Dr. Lewis Gregory Cole of the Friedenwald Medal of the American Gastroenterological Association, for 1945, in recognition of his outstanding contributions to medicine. Dr. Cole was a pioneer in radiology in America. His work with x-rays dates back to 1899, and his first paper, "Skiagraphic Errors: Their Causes, Dangers, and Prevention," was published in 1904. He has been a member of the Radiological Society of North America for twenty-five years.

BRONZE STAR MEDAL AWARDED TO DR. LAURISTON S. TAYLOR

On Oct. 20, 1945, Dr. Lauriston S. Taylor, Chief of the X-Ray Section, U. S. Bureau of Standards, was awarded the Army's Bronze Star Medal for meritorious service. Dr. Taylor was associated with the Operations Analysis Branch of the Army Air Forces, serving in the European theater of operations from May 1943 to June 1945.

The citation accompanying Dr. Taylor's award commended him for outstanding leadership, analytical ability, and technical skill demonstrated while he was chief of the Operational Research Section of the 9th Bombardment Division. Under his direction, the efficiency of lead crews increased, a highly efficient program of bridge interdiction was scheduled, and bombing accuracy greatly improved.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

THE 1945 YEAR BOOK OF RADIOLOGY. Diagnosis, edited by CHARLES A. WATERS, M.D., Associate in Roentgenology, Johns Hopkins University; Assistant Visiting Roentgenologist, Johns Hopkins Hospital; Associate Editor, WHITMER B. FIROR, M.D., Assistant in Roentgenology, Johns Hopkins University; Assistant in Roentgenology, Johns Hopkins Hospital (on leave with the Armed Forces). Therapeutics, edited by IRA I. KAPLAN, B.Sc., M.D., Director, Radiation Therapy Department, Bellevue Hospital, New York City; Clinical Professor of Surgery, New York University Medical College. A volume of 464 pages, with 342 illustrations. Published by The Year Book Publishers, Inc., Chicago, Ill. Price \$5.00.

DR. W. C. RÖNTGEN. By OTTO GLASSER, Cleveland Clinic Foundation. A volume of 169 pages. Published by Charles C Thomas, Springfield, Ill., 1945. Price \$4.50.

II^e CONGRÈS INTERNATIONAL DE LUTTE SCIENTIFIQUE ET SOCIALE CONTRE LE CANCER, BRUXELLES 20-26 SEPTEMBRE 1936. TRAVAUX SCIENTIFIQUES, publics sous la direction de MME. LE DOCTEUR MARTA FRAENKEL. Tome I. Rapports généraux dans leur langue originale et suivis de résumés en six langues. Ligue Nationale Belge contre le Cancer, Bruxelles, 1936.

PHYSICAL CHEMISTRY OF CELLS AND TISSUES. By RUDOLF HÖBER, University of Pennsylvania School of Medicine, Philadelphia. With the collaboration of DAVID I. HITCHCOCK, Yale University School of Medicine, Laboratory of Physiology, New Haven, Conn., J. B. BATEMAN, Mayo Clinic, Rochester, Minn., DAVID R. GODDARD, University of Rochester, Biological Laboratories, Rochester, N. Y., and WALLACE O. FENN, University of Rochester, School of Medicine and Dentistry, Rochester, N. Y. A volume of 676 pages, with 70 illustrations. Published by The Blakiston Company, Philadelphia. Price \$9.00.

Book Reviews

THE OSSEOUS SYSTEM. A HANDBOOK OF ROENTGEN DIAGNOSIS. By VINCENT W. ARCHER, M.D., Professor of Roentgenology, University of Virginia, Department of Medicine. A volume of 320 pages, with 148 plates. Published by The Year Book Publishers, Inc., Chicago, 1945. Price \$5.50.

In *The Osseous System*, which is the fourth of a projected series of six Handbooks on Roentgen Diagnosis to be issued under the imprint of the Year Book Publishers, Dr. Archer combines interest with instruction. As a handbook should, this volume of modest proportions deals with an extensive field concisely but adequately, covering all the essential features but making no attempt at a detailed exposition of every phase of the subject.

The contents are divided into five main sections: (1) *Technic; Principles of Interpretation; Roentgen Anatomy*; (2) *Injuries to the Skeletal System Other than the Spine*; (3) *The Spine*; (4) *Bone Diseases and Abnormalities in Childhood*; (5) *Bone Diseases Occurring Principally in Adult Life*.

In the second and third sections the material is arranged in general on a regional basis. The various bones of the skeleton and the different areas of the spine are taken up separately. In each instance there is an introductory section on the best technic for the area in question, followed by remarks on the roentgen anatomy and the physiological changes, injuries, and diseases likely to be encountered. Personal observations, showing the background of a long and valuable clinical experience, add greatly to the value of the discussions.

In the section on bone disturbances in children

the conditions are grouped somewhat loosely according to the predominant radiologic characteristics, as periosteal thickening, increase in bone density, developmental defects, etc. A somewhat similar plan is followed in the section on bone diseases in adults.

The book is amply illustrated, lists of references are supplied, and there is a useful index. Dr. Archer dedicates his book to "the occasional radiographer." It should prove valuable not alone to that group, but to all radiologists seeking a concise review of the roentgen aspects of bone lesions.

THE INTERVERTEBRAL DISC, WITH SPECIAL REFERENCE TO RUPTURE OF THE ANNULUS FIBROSUS WITH HERNIATION OF THE NUCLEUS PULPOSUS. Second Edition. By F. KEITH BRADFORD, M.D., Houston, Texas, and R. GLENN SPURLING, M.D., Louisville, Kentucky. A volume of 192 pages, with 70 illustrations. Published by Charles C Thomas, Springfield, Ill., 1945. Price \$4.00.

In this small volume the authors have assembled all the important information which has been accumulated regarding the intervertebral disk and its disturbances. The average reader will be most interested in the chapters on the clinical and roentgenological investigation of the patient, treatment, and results. For those desiring to obtain a more comprehensive knowledge of the subject there are introductory chapters on the embryology, anatomy, physiology, and pathology of the intervertebral disk.

This second edition has been brought up to date by comments regarding the use of pantopaque in myelography and a discussion of the findings associated with small, lateral, cervical herniations of the nucleus pulposus resulting in severe pain in the neck and arms. The bibliography at the end of the volume now contains 307 references, as compared with 258 papers referred to in the first edition.

As the authors mention, there remain several controversial points regarding this subject. For one thing, there is not yet general agreement as to the name of the clinical pathological entity under discussion. The name suggested in this volume, "rupture of the annulus fibrosus with posterolateral (or posterior) herniation of the nucleus pulposus," seems too cumbersome to become generally accepted. It is correctly stated that it is too early as yet to evaluate the late results of operative treatment. Likewise, the question as to whether spinal fusion should be combined with removal of the herniated nucleus is not definitely decided. Lumbar puncture as a possible cause of herniation of the nucleus pulposus is discussed, and although no reported cases have been attributed to this cause, it is felt to involve distinct danger, which should be avoided by careful technic.

The material is presented in an interesting, readable manner, free from tiresome repetition and with numerous helpful illustrations. Anyone familiar

with the information contained in this monograph should have little difficulty in making the proper diagnosis in the usual case of herniated nucleus pulposus.



Fauntleroy Flinn, M.D.

In Memoriam

FAUNTLEROY FLINN, M.D.

1890-1945

Dr. Fauntleroy Flinn, of Decatur, Ill., died on July 26, 1945. Dr. Flinn was born in Alberta, Va., and was educated at Randolph-Macon College and the Medical College of Virginia. He was associated with the U. S. Public Health Service, Hospital No. 32, in 1920-22 and with the U. S. Bureau of Mines from 1922 to 1926. From 1926 until his death he was Director of the Department of Radiology, St. Mary's Hospital, Decatur, Ill. He was, also, from 1930, radiologist at Wabash Employees' Hospital.

Dr. Flinn served as a member of the Advisory Board for the Division of Cancer Control of the Illinois Health Department and as radiologist on the Selective Service Medical Advisory Board for his state. He was a fellow of the American College of Radiology and a member of the Radiological Society of North America and of the Illinois Radiological Society. He was a member, also, of the Decatur Trail Riders Association.

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Editor's Note.—Will secretaries of societies please cooperate by sending information to Howard P. Doub, M.D., Editor, Henry Ford Hospital, Detroit 2, Mich.

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ECHLIN, FRANCIS A., IVIE, JOSEPH McK., AND FINE, ARCHIE. Pantopaque Myelography as an Aid in the Preoperative Diagnosis of Protruded Intervertebral Discs: Preliminary Report.....	
COHN, T. C., AND COHN, H. Low-Back Pain as the Presenting Symptom of Malignant Breast Tumors.....	
DEHNE, ERNST. Fractures at the Upper End of the Humerus. A Classification Based on the Etiology of the Trauma.....	
MOORE, ROBERT D. Conservative Management of Adolescent Slipping of the Capital Femoral Epiphysis.....	
RICHMOND, DAVID A. Fatigue Fracture of the Fibula. Report on Two Cases.....	
NICKERSON, SAMUEL H. Pathology of the Anomalies Found in Knee Joints.....	
BRANDBERG, OLOF. Skeletal Changes in the Acute Leukoses of Children.....	100
Gynecology and Obstetrics	
MACDONALD, COLIN. Hysterosalpingography in Sterility.....	100
SHEFFERY, JOSEPH B. Hysterosalpingography as Diagnostic Aid in Certain Types of Ruptured Uteri.....	100
HUDGINS, A. P. X-ray Studies in Hysterosalpingography, Using a New Cannula.....	101
The Genito-Urinary System	
FLOCKS, R. H. Preventive Treatment of Calcium Urolithiasis: Important Role of Early and Frequent Roentgenographic Examinations..	101
MARTIN, JOHN W. Renal Cyst, Solitary.....	101
BODNER, HENRY, AND MOULDER, MAX K. An Unusual Horseshoe Kidney: Case Report..	101
The Spinal Cord	
EHNI, GEORGE, AND LOVE, J. GRAFTON. Intraspinal Lipomas. Report of Cases, Review of	

the Literature, and Clinical and Pathologic Study.....	102
--	-----

RADIOTHERAPY

98 SPENCER, R. R. Problems of Cancer Biology...	102
CARLING, E. ROCK, STEBBING, GEORGE F., NUTTALL, JOHN R., ET AL. Discussion on Post-War Organization for the Treatment of Cancer.....	102
WIENER, KURT. Cancer Treatment with Radium Bearing Moulds.....	102
98 SNTIMAN, MAURICE F. Individualization in the Management of Carcinoma of the Maxillary Sinus.....	102
99 ACKERMAN, LAUREN V., WILEY, H. M., AND LEMONE, DAVID V. Necrotizing Bronchopneumonia: Its Relation to Radiation Therapy of Cancer of the Oral Cavity.....	102
99 GILES, ROY G. Irradiation in Carcinoma of the Breast.....	102
SANDLER, BERNARD. Principles of Treatment of Carcinoma Cervix Uteri by Radiotherapy..	102
WATT, JAMES. Effect of Deep X-Rays on the Peritoneal Metastases of an Ovarian Carcinoma.....	102
BOTHE, A. E. Relationship of Epithelial Buds to Carcinoma of the Pelvis of the Kidney, Ureter and Bladder.....	102
HAM, HAROLD J. Carcinoma of the Prostate....	102

EFFECTS OF RADIATION

STEVENSON, LEWIS D., AND ECKHARDT, ROBERT E. Myelomalacia of the Cervical Portion of the Spinal Cord, Probably the Result of Roentgen Therapy.....	102
STOWELL, ROBERT E. The Effects of Roentgen Radiation on the Thymonucleic Acid Content of Transplantable Mammary Carcinomas.....	102
LEVINE, MICHAEL. Effect of Colchicine and X-Rays on Onion Root Tips.....	102



ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Diffuse Neurofibromatosis (von Recklinghausen's Disease) Involving the Bulbar Conjunctiva. Report of a Case, with Lesions of the Skeletal System and Skin, Bodily Asymmetry and Intracranial Involvement. Francisco Pérez Allende. Arch. Ophth. 33: 110-115, February 1945.

appeared to overlie tuberos nodules in the cerebral cortex. It is suggested that the calvarial changes are related to puberty in some manner, but no further explanation is offered.

JOHN F. HOLT, M.D.
(University of Michigan)

Aerosinusitis—A Résumé. Paul A. Campbell. Ann. Otol., Rhin. & Laryng. 54: 69-83, March 1945.

Prior to World War II with its emphasis upon high altitude flying and the institution of an Altitude Training Program based on simulated flight, barometric pressure changes were of chief concern in caisson workers and deep-sea divers, where they manifested themselves more spectacularly in decompression sickness and anoxia. The aerosinusitis which may be produced by differences in barometric pressure between the air or gas within the sinuses and that of the surrounding atmosphere is commonly characterized by congestion and inflammation of the lining structures, frequently with pain over the sinus area and with or without mucosal or submucosal hemorrhage. The frontal and maxillary sinuses are the sites of predilection.

Two types of aerosinusitis are recognized: a non-obstructive form due to the presence of pus, fluid, or mucus covering the ostium of the sinus, and an obstructive form due to a blocking of the ostium by redundant tissue or an anatomical defect. In the first type the change in pressure incident to descent may press the fluid or other material into the sinus, and infection of the lining mucosa may ensue, though this is rather unusual unless the membranes have been severely barotraumatized, by virulent organisms. In the second type, the mechanism may be that of a flap valve formed by a small polyp or a bit of tissue. During ascent the flow of air or gaseous content is outward, and the flap is merely pushed aside and the pressure equalized. On descent, however, the flap is pressed against the ostium by the heavier outside atmosphere (or sucked in by the lighter inside air) and an airtight seal is formed. Swelling of the mucosa and fluid production represent an attempt to equalize the inner and outer pressures. As soon as sufficient space is filled, the flap valve is released and recovery begins.

The author presents a series of roentgenograms from a patient with mucosal hematoma formation. The x-ray picture made following an altitude chamber flight shows a large dome-shaped swelling of mucous membrane in the left frontal sinus not present earlier. Subsequent films demonstrated a slow resolution of the process with complete recovery after about five months. The roentgenographic findings in non-obstructive aerosinusitis are, in most instances, not diagnostic, as the amount of fluid or pus pressed into the sinus is never large.

Aerosinusitis must be differentiated from purulent and catarrhal sinusitis. A history of pain over one or more of the sinuses during or shortly after exposure to extensive barometric pressure change is suggestive, as is epistaxis during or after such exposure. Roentgenologic plates disclosing opacity or a thickened lining membrane in the absence of previous sinusitis are strongly indicative of the diagnosis.

A case of diffuse neurofibromatosis (von Recklinghausen's disease) involving the bulbar conjunctiva, with histologic confirmation, is reported. The patient, an 18-year-old girl, the twin of an apparently healthy boy, also presented asymmetry of the body, cutaneous tumors, partial alopecia of the scalp on the side of the affected eye, skeletal lesions, intracranial involvement, and epilepsy. The lesions were congenital.

Roentgenograms, which are reproduced here, show a craniofacial asymmetry, with protrusion of the region corresponding to the scala of the right temporal bone. The right orbit is larger than the left. The cranium tends to be tower-shaped, owing to the greater development of the dome than of the base. The frontoparietal region is thinned, with little difference in the layers of bone, through atrophy of the diploe and accentuation of the inner cortical layer. The middle fossa of the cranium is asymmetric, being deeper on the right side, due to internal compression by the right temporal bone. The sella turcica is larger than usual, especially in the anteroposterior diameter. It is deformed, particularly at the expense of the posterior clinoid processes. The venous furrows in the right parietal region are accentuated, and "digitate" impressions are present in the left frontoparietotemporal region. On the right side a series of calcium shadows extends from the middle fossa of the cranium to the vertex; some of these are semicircular and give the impression of being clustered. These calcifications probably circumscribe a series of neurofibromatous endocranial formations. The pelvis appears moderately asymmetric, owing to the lesser development of the bones which form the left side of the pubis.

X-ray studies of the chest were normal. The bones of the right arm were more developed than those of the left arm; the left leg was shortened. The inner surface of the upper third of the left tibia presented exostoses. A photomicrograph of the conjunctival tumor is reproduced.

Characteristic Roentgenographic Changes Associated with Tuberos Sclerosis. W. W. Dickerson. Arch. Neurol. & Psychiat. 53: 199-204, March 1945.

Tuberos sclerosis is one of the entities to be given consideration in differential diagnosis when multiple focal calcium deposits are observed in skull roentgenograms. It has been pointed out and widely accepted that such concretions are located within the brain substance. Dickerson, on the other hand, states that a more characteristic finding in the disease consists of patchy areas of increased density within the calvarium itself. This observation is proved beyond doubt by careful examination of autopsy material from three patients with typical signs of tuberos sclerosis. Histologically, the diseased areas in the skull showed osteosclerosis and replacement of normal bone marrow by fat. Many, if not all, of these islands of abnormal bone

The milder cases of this manifestation of barotrauma are self-limited, resolution taking place in from a few hours to a few days. The author makes some suggestions as to prophylaxis and treatment but concludes that the ultimate solution of the problem lies with the aeronautical designer and engineer.

STEPHEN N. TAGER, M.D.

Osteoma of the Frontal Sinus. Report of Five Cases. James R. Dowling. *Arch. Otolaryng.* 41: 99-108, February 1945.

Primary osteoma of the frontal sinus is not a common lesion. Since the majority of case reports appear in the European literature and 2 of the 5 patients in the present series were German prisoners of war, it may be that the lesion occurs more frequently among Europeans than among Americans. Males are more commonly affected, usually in the second and third decades of life. The etiology is obscure. Embryonic rests, trauma, and repeated infections of the frontal sinus, resulting in abnormal activity initiating tumor formation, have been suggested as possible causes. The presence of an osteitis of the frontal bone over a small area lateral to and above the upper margin of the sinus in 2 of the author's cases lends support to the last theory. The 5 cases are presented in full, with numerous illustrations.

Osteoma is a slow-growing benign tumor. It is malignant only mechanically, i.e., through its capacity of enormous development and its situation in direct proximity to vital organs. Morphologically two types are recognized—the hard, ivory-like, eburnated type and the softer cancellous one. Microscopically, there may be great variations.

The greater number of cases of osteoma reported in the last few years is not in the author's opinion an indication that the tumor has become more common but is attributable to more frequent roentgen examination, with the discovery of cases which otherwise would have been undiagnosed. The lesion is often present a long time before any symptoms appear. Dizziness, headaches, and deformity may occur. The tumor may extend externally through the outer table, internally into the anterior cranial fossa, or inferiorly into the orbit. The symptoms are determined by the structure upon which the pressure of the expanding growth is exerted.

The only treatment for osteoma of the frontal sinus is surgical removal. When the tumor is small and asymptomatic, it is possible to observe the progress by repeated roentgen examinations. If the entire sinus is involved, with or without extrasinusal involvement, surgical intervention should not be too long deferred. Three of the author's patients were operated upon with good results.

Problems in X-Ray Localization of Foreign Bodies In and About the Eye. J. A. MacMillan. *Canad. M. A. J.* 52: 173-175, February 1945.

Radiographs should be made of all patients suspected of having a foreign body in or about the eye. Anteroposterior and lateral films should be made and, if the foreign body cannot be definitely placed outside the globe, a localizing procedure should be done. This should show whether the foreign body is within or outside the globe and whether there has been any change in position after failure of magnet extraction; it should also determine the closest proximity of the foreign body

to a point in the sclera from which it may be removed. The author describes briefly several general methods for x-ray localization. He considers the Sweet method as the most accurate, but since the apparatus is expensive and is not generally available, he suggests one of the simpler procedures, as the contact lens method of Comberg, as perhaps best for smaller medical centers.

The records of the author's last 100 patients with traumatic foreign body are reviewed. Fifteen of them had perforating lesions of the globe, making x-ray unnecessary. In 16 others, accurate localization was not done. In 20 of these 31, the foreign bodies were removed by magnet extraction. In the remaining cases, the Sweet method of localization was used. In one, the foreign body was not shown, though it was subsequently removed by the magnet. In 3, the foreign body was localized outside the globe, but was removed from the globe by the magnet. In 7 cases the foreign body was non-magnetic, and in 2 of these enucleation was required. In 29 of the series of 100, enucleation was necessary and in 55 cataracts developed.

The author notes that in one case, a BB shot was removed by the magnet, and he points out that, for some of these shot are made of magnetic metal. A magnet should be tried in all cases where shot is present.

BERNARD S. KALAYJIAN, M.D.

THE CHEST

Bronchography as a Diagnostic Aid in Chest Disease. George S. McReynolds, Jr., and Fred W. Shelton. *Am. Otol., Rhin. & Laryng.* 54: 114-124, March 1945.

In diseases of the chest, bronchography with contrast iodized oils to outline the tertiary bronchi and the peripheral bronchial tree provides additional information concerning areas inaccessible to vision through the bronchoscope.

In adults, the procedure is carried out under intravenous anesthesia (pentothal in a 2 per cent solution, without epinephrine). The catheter method described by Jackson and Bonnier (*Ann. Otol., Rhin. & Laryng.* 46: 77, 1937) is used, the oil being introduced under fluoroscopic guidance. Only one lung is filled at a time, and both anteroposterior and lateral views are taken.

In children, the authors have successfully used iodized oil instillation under general (ether) anesthesia. With the patient in third-stage anesthesia, the larynx is exposed with a laryngoscope and the bronchoscope introduced. A flexible-tipped bronchial aspirator is passed through the bronchoscope and any secretion in the bronchial tree is aspirated. The syringe containing the iodized oil is then connected to the aspirator and the oil is injected, under fluoroscopic visualization, into the desired lobe or lobes. X-ray films are taken at once, without moving the child. Usually both the right and left bronchial trees are filled at one time to obtain the necessity of repeating the general anesthesia, though this is a matter to be determined in the individual case. The procedure should not be used in acutely ill children, and the acute exudative form of pulmonary tuberculosis has generally been considered a contraindication, though the present trends in endoscopy in pulmonary tuberculosis tend to dispel the fear of using iodized oil in acid-fast infections.

Illustrative cases in both adults and children are recorded.

The author does not consider bronchography as a substitute for bronchoscopy but as an adjunct.

diagnostic bronchoscopy should invariably precede the instillation of iodized oil. STEPHEN N. TAGER, M.D.

Early Diagnosis of Diseases of the Chest. Norman J. Wilson. *New England J. Med.* 232: 301-309, March 15, 1945.

Mass surveys of the chest have shown that many patients have subclinical disease which is in a curable stage, particularly tuberculosis and carcinoma. The mass survey should find early lesions, and pooled specimens of sputum, gastric aspiration, bronchography, bronchoscopy, and biopsy should establish the diagnosis.

The high value of the mass x-ray survey is indicated by the fact that in large series of hospital admissions about 9 per cent of the patients will have significant thoracic disease, while routine blood counts show only about 1.0 per cent blood dyscrasias, urinalysis reveals diabetes in about 0.4 per cent, and routine serologic tests show syphilis in about 2.0 per cent.

JOHN B. MCANENY, M.D.

Advantages of Supplemental Radiographic Studies at Time of Induction. A. C. Galluccio. *Mil. Surgeon* 96: 262-265, March 1945.

A study of 366 pre-inductees was made to determine the desirability and practicability of adding other roentgenographic studies to the present single x-ray examination of the chest at induction. Thirty per cent of the men examined were found to have pathema of some degree. Fifty-two of 103 roentgenograms of the lumbar spine and abdomen showed some abnormality; in 24 of these cases congenital anomalies of the lumbosacral area of varying extent and significance were found. In only 27 of the 145 gastro-intestinal series, on the other hand, were the findings such as to warrant this type of examination.

The men in this series were referred for roentgen study because of some abnormality in the clinical picture. Any large number of inductees routinely examined would naturally show a much lower percentage of positive findings.

An analysis of the data obtained would seem to indicate the desirability of supplementing the routine chest film at induction with a flat film of the abdomen taken in the supine position. This would reveal the presence of congenital anomalies of the lumbosacral area, which are important because of their frequency and their association with low back pain and limitation of motion. It would also be helpful to all concerned to know, for example, that a soldier complaining of pain in the dorsal area after one year of service had minimal osteoarthritic changes on induction, or that the induction film of a soldier with renal colic did or did not reveal a calculus. This information as to the time of origin of the disease process or injury would be of aid in evaluating claims for pension benefits, and the slight added initial cost to the government would be amply repaid.

Tuberculosis in the Canadian Army 1939 to 1944. J. D. Adamson, W. P. Warner, R. F. Keevil, and R. E. Beamish. *Canad. M. A. J.* 52: 123-127, February 1945.

This study is one of the incidence of tuberculosis in the Canadian army, with a comparison of the findings among troops stationed in Canada with those overseas. In all of the troops, there has been a gradual but definite increase in incidence in the past five years. The increase may be more apparent than real, however, since

more thorough methods for study of suspected cases and contacts have been applied. This is indicated by the fact that the percentage of minimal lesions discovered has more than doubled, 55 per cent in 1944 as compared with 27 per cent in 1942.

The incidence of all forms of tuberculosis has been found to be greater among the overseas troops than in those stationed in Canada. In the latter group, the incidence corresponds very closely to that of the civil population. Overseas troops coming from the provinces of Canada where the civil death rate from tuberculosis is low almost invariably show a greater incidence of all forms of the disease than those from provinces where the civil death rate is relatively high. The total rates for all forms of tuberculosis are roughly twice as high overseas as in Canada, undoubtedly due to greater opportunity for exposure to open cases in the countries to which these troops have been sent.

BERNARD S. KALAYJIAN, M.D.

Mass X-Ray Survey in San Antonio. David M. Gould. *Public Health Rep.* 60: 117-126, Feb. 2, 1945.

In 1942, a tuberculosis survey was carried out in San Antonio, which has had the highest tuberculosis death rate of any large city in the United States, a 35-mm. photofluorographic unit being employed. A 14 X 17-inch chest film was taken in suspicious cases. This survey revealed that 993 (4.9 per cent) of the 20,350 persons examined had reinfection tuberculosis, minimal, moderately advanced, or far advanced. In addition, 200 persons (1.0 per cent) were found to have cardiac abnormalities; 91 (0.4 per cent) had massive calcification; 258 (1.3 per cent) suspicious tuberculosis; 125 (0.6 per cent) fibrosis; and 102 (0.5 per cent) had other types of chest disease.

Of the 20,350 persons examined, 12,920 were female and 7,430 were male; of the females, 4.7 per cent had reinfection tuberculosis; of the males, 5.2 per cent. Over 90 per cent of the series were of Latin-American extraction; only a small number were Negroes. Very slight differences in the proportion of reinfection tuberculosis were observed between the Anglo-Americans and the Latin-Americans. The true incidence of tuberculosis among the Anglo-Americans in San Antonio is probably lower than the figure obtained in this survey, because of the relatively small numbers examined and because the few that presented themselves made a considerable effort to seek out the survey in the Latin-American quarter. The most obvious reason why one Latin-American out of 20 was found to have tuberculosis is poverty, with accompanying unsanitary living conditions, inadequate diet, and lack of medical care.

Tuberculous Pleurisy with Effusion in Infancy. Janet B. Hardy and Edwin L. Kendig, Jr. *J. Pediat.* 26: 138-148, February 1945.

A diagnosis of pleurisy with effusion was made in 13, or 3.3 per cent, of 393 children with tuberculosis at the Harriet Lane Home, Baltimore. The age of the patients at the time the effusion occurred ranged from ten to twenty-eight months. The incidence in Negro children was 4.2 per cent; in white children, 1.5 per cent. The demonstration of tubercle bacilli by culture or guinea-pig inoculation of the pleural fluid provided positive proof of the diagnosis in slightly less than one-half of this series. Calcification in the pleura after disappearance of the fluid completed the diagnosis in one patient.

The milder cases of this manifestation of barotrauma are self-limited, resolution taking place in from a few hours to a few days. The author makes some suggestions as to prophylaxis and treatment but concludes that the ultimate solution of the problem lies with the aeronautical designer and engineer.

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weeks after the initial infection, is characterized by acute respiratory disease frequently associated with erythema nodosum and/or erythema multiforme, and arthritic symptoms. The subacute or chronic active phase follows the disappearance of acute clinical manifestations, while roentgen evidence of pulmonary activity persists. This period lasts from weeks to months. In the third stage, clinically silent lesions may be demonstrated roentgenographically.

The roentgen findings in primary coccidioidomycosis vary, but the initial pulmonary infection commonly resembles childhood tuberculosis or bronchopneumonia. One of the more common manifestations of the chronic stage is the appearance of single or multiple nodular lesions in the lung, which may be confused with nodular tuberculous lesions or metastases from a primary tumor. Careful study of the roentgenograms with a magnifying lens will usually reveal serration of the edges of the lesions.

With modern rapid transportation facilities and increase in migration of populations, coccidioidomycosis may be seen throughout the entire United States. The possibility of this infection, particularly in children returning from endemic areas in the Western states, should be kept in mind.

Silicosis in Foundries of Naval Gun Factory. Edwards M. Riley, Robert W. Butler, and Sidney Goren. U. S. Nav. M. Bull. 44: 653-660, March 1945.

Two silicosis surveys were made at a naval gun factory, one in 1939 and one in 1944. The 1939 survey showed 11 cases of silicosis among 454 employees, an incidence of 2.4 per cent. In addition, there were 17 borderline cases (3.7 per cent). Eleven cases of tuberculosis were found (2.4 per cent). It is clear, in view of these findings, that definite silicosis hazards existed despite the fact that the majority of the employees shown to have the disease had had longer service in other factories than in Navy Yards. Between 1939 and 1941, the number of men in the steel foundry was almost tripled and certain active measures were subsequently taken to reduce the dust hazard, which was visibly increased with this enhanced activity. The effectiveness of these measures was shown by greatly reduced dust counts in the various occupational groups, the average reduction being approximately 65 per cent.

In the 1944 survey, 895 workers were examined; 842 were studied roentgenographically, with 4 × 5-in. stereoscopic films. All cases showing evidence of pathological change were restudied, the procedure including a detailed history, physical examination, and 14 × 17-in. films. Of the 895 workers, 63 per cent had been exposed to dust for a period of time normally considered long enough for development of silicosis. However, only 18, or 3.2 per cent of this group (2.1 per cent of the total group), showed any evidence of silicosis. Of these, 15 were in stage one, 2 in stage two, and 1 in stage three. In both stage-two cases, the disease was undoubtedly present before employment in the Navy Yard, but since routine pre-employment examinations and chest radiographs were not made prior to this time, the condition had not been discovered. A large percentage of the patients are symptom-free and those few complaining of cough proved to be excessive smokers. Thirteen cases of tuberculosis (1.5 per cent) were found in this second survey.

BERNARD S. KALAYJIAN, M.D.

Pulmonary Roentgenographic Changes Due to Mitral Stenosis Simulating Those Due to Silicosis. Henry W. Ryder and H. G. Reincke. Am. Heart J. 29: 327-338, March 1945.

The authors present a case in which a diagnosis of silicosis had been made, based on three different x-ray examinations, prior to their observation. The patient, a white male, aged 26, had not been engaged in any occupation considered as a dust hazard prior to April 1943. At the time of the original diagnosis (July 1943) he had been employed for eighty-three days in a building in which a crusher of filter material was operated. The filter material consisted of finely ground silica, with a binder of potassium silicate. It was received in large pieces and crushed to lumps about the size of a finger tip. The silica was not ground and the filter material was not prepared at this site. Exhaust ventilation was in practice and the operation was not considered a dusty one. The major part of the patient's work was done at some distance from the crusher.

The case came to the authors' attention in October 1943. At that time a physical examination showed the aortic sound, pulmonic sound, and second heart sound at the mitral area to be widely split. The first sound at the mitral area was markedly accentuated; the pulmonic second sound was sharp and accentuated. There was a rumbling holodiastolic bruit, with presystolic accentuation at the apex. In the absence of aortic insufficiency, this bruit was interpreted as being pathognomonic of mitral stenosis. EKG changes were present. Roentgen examination of the chest showed diffuse mottling, an accentuation of the pulmonary conus, and an enlargement of the left auricle.

This case is presented as illustrative of the fact that repeated roentgen studies are not of themselves sufficient basis for a diagnosis of silicosis. Hazardous exposure to silica dust had not occurred, clinical evidence of pulmonary disease was lacking, and the roentgen changes proved to be those of pulmonary congestion resulting from mitral stenosis.

The authors quote a number of authorities on the pulmonary changes in mitral stenosis, with special reference to the occasional case with a miliary appearance strongly suggestive of miliary tuberculosis or pneumoconiosis.

HENRY K. TAYLOR, M.D.

Idiopathic Pulmonary Hemosiderosis (Essential Brown Induration). Per Selander. Acta paediat. 31: 286-299, March 25, 1944. (In German.)

A case of idiopathic pulmonary hemosiderosis coming to autopsy is recorded. The patient was a girl of eight with a history of respiratory difficulty from birth. Following an attack of whooping cough early in 1941, at the age of seven, the patient continued to cough for some time. Toward the end of the year dyspnea became more severe, anemia developed, and blood-streaked sputum was observed. Roentgen examination showed silicosis-like changes in the lungs. Death occurred a year after the exacerbation of symptoms. Roentgenograms and photomicrographs show the iron deposits in the lungs and hilar lymph nodes. No iron deposits were present in the liver or spleen.

Spontaneous Mediastinal Emphysema. Samuel A. Shelburne. U. S. Nav. M. Bull. 44: 610-613, March 1945.

Mediastinal emphysema may appear suddenly without previous injury, accompanied by severe pain over

the heart and sternum, with crackling, bubbling and crunching sounds over the heart, which may be mistaken for a pericardial or pleural friction rub. The author describes two cases and calls attention to the x-ray sign of a sharp line around the borders of the heart which disappears on subsequent films.

BERNARD S. KALAYJIAN, M.D.

Multiple Congenital Arteriovenous Aneurysms in the Pulmonary Circulation. John H. Sisson, George E. Murphy, and Elliot V. Newman. Bull. Johns Hopkins Hosp. 76: 93-111, March 1945.

A case of multiple congenital arteriovenous aneurysms in the pulmonary circulation in a 45-year-old colored woman is presented. Six months before admission to the hospital the patient had a sudden attack of sharp, non-radiating epigastric pain, with shortness of breath. Three similar attacks followed at fortnightly intervals. A fifth attack occurred a month before admission, with severe dyspnea, dizziness, and nausea. The nausea continued, with daily vomiting, until admission. The ankles were edematous. Four days prior to entry the patient coughed up a small amount of bright red blood and complained of a transient numbness in her left arm and shoulder, with paralysis of the left thumb and index finger. She had lost 35 pounds in the last four months.

Examination showed cyanosis, clubbing of the fingers, hemangiomas, and a bruit over the chest. A postero-anterior film of the chest revealed an enlarged left ventricle and a round opaque area with well defined sharp borders to the left of the left ventricle. The lungs were otherwise clear. Fluoroscopy showed a normal aortic knob and pulmonary conus. The right auricle pulsated vigorously. The mass described above shifted up and down with the respiratory movements. It was not attached to the heart and showed no marked pulsation. It was best seen in the left anterior oblique position, lateral to the left ventricle. Bronchograms revealed no communication between the mass and the bronchi.

The patient was tested for sensitivity to diodrast by giving 10 c.c. of a 35 per cent solution intravenously and had no reaction. Seven days later a nylon catheter was inserted into the right auricle *via* the cubital, axillary, subclavian, and innominate veins, and superior vena cava, according to the technic of Courmand, and 35 c.c. of 70 per cent diodrast was introduced directly into the right auricle *via* the catheter in two seconds. Four pictures were taken in the next thirteen seconds. Although the patient had received luminal (128 mg.) and morphine sulfate (10 mg.) intramuscularly an hour before, she was quite apprehensive after the procedure was completed. She had severe asthmatic respirations with quick inspiration and noisy difficult expiration, and commented that she felt she was going to have an attack similar to those described in the present illness. Profuse perspiration developed and asthmatic wheezes were audible at both lung bases. Aminophylline was given intravenously. Coarse râles spread throughout both lungs, pink frothy sputum flowed from the mouth, and despite the immediate use of oxygen, intracardiac adrenalin, tourniquets, and artificial respiration, the patient died twenty-five minutes after the injection of the dye. The exact cause of death could not be accurately determined.

The autopsy findings are given in detail and the case is compared with 5 cases previously reported as cavernous hemangioma or arteriovenous fistula of the lung.

It is concluded that multiple congenital arteriovenous aneurysms should be suspected when one finds clubbing, cyanosis, dizziness, dyspnea, fatigue, polycythemia, and roentgenographic evidence of unusual pulmonary opacity.

The authors believe that the intravenous use of diodrast should be approached with caution in patients with hypertensive cardiorenal disease and analyze 12 previously reported cases of death following within one hour the intravenous injection of diodrast in diagnostic procedures.

Chronic Stridor in Early Life Due to Persistent Right Aortic Arch. Report of Two Cases. Harold K. Faber, John W. Hopc, and Francis L. Robinson. J. Pediat. 27: 128-137, February 1945.

Two cases of persistent right aortic arch in infancy are reported, bringing the total number of cases diagnosed during life to 6.

Difficulty in swallowing is common in patients with persistent right aortic arch and was present in both of the authors' cases. More conspicuous in children is noisy breathing, accentuated during exertion or feeding, and at times severe enough to cause retraction of the suprasternal notch, rib cage, and epigastrium, cyanosis, and even extreme extension of the head. During the stridor tends to diminish or disappear. Respiratory infections are likely to cause exacerbations of the obstructive symptoms.

Diagnosis of this condition during life is entirely dependent upon roentgen examination but, since special techniques are necessary, the anomaly will almost certainly be missed unless the clinician or radiologist looks specifically for it. It must be differentiated from mediastinal tumor, aneurysm of the aorta and, especially in infants, enlargement of the thymus. Barium in the esophagus is essential to diagnosis. The most characteristic roentgen features are the anterior displacement of the esophagus at the level of the bifurcation of the trachea (lateral view) and a rounded filling defect of the esophagus which, in the anterior view, is displaced to the left. The knob of the right aorta can be seen behind the esophagus as a round mass, while the normal left aortic knob is absent. In the anterior view in some cases at least, the right aortic arch stands out boldly at the right of the vertebral column above the heart shadow as a rounded prominence, which might easily be mistaken for the enlarged right lobe of the thymus. Arkin (Am. Heart J. 11: 444, 1936) points out the value of the right anterior oblique view, which best brings out the position of the aorta behind the esophagus, the forward displacement of the esophagus and trachea, and the appearance of the aortic knob under the sternal end of the right clavicle, separated from the heart shadow by a characteristic light band representing the trachea and right main bronchus. Careful fluoroscopic examination will usually reveal pulsation of the prominence in the right upper mediastinal shadow and at the margins of the filling defect in the esophagus. A pulsation may also be seen by bronchoscopy or esophagoscopy and may be demonstrated by kymography or by angiograms with opaque substances in the blood stream. The latter method is, however, too cumbersome and uncertain to be of much practical value. Kymography, according to the method of Arana and Aguirre (Arch. argent. de pediat. 11: 331, 1940) should be employed routinely in all suspicious cases. In double aortic arch, with total persistence of the left

arch, the esophagus is not pushed to the left but is uniformly constricted.

In congenital or chronic stridor not due to obvious causes, persistent right aortic arch should always be considered. The diagnosis of enlarged thymus and "thymic stridor," based on a broad shadow in the upper mediastinum, should not be accepted until a persistent right arch has been excluded.

An Evaluation of Teleroentgenographic Mensuration and Cardiac Roentgenoscopy in the Diagnosis of Early Mitral Valve Disease. Bernard S. Epstein. *Am. J. Roentgenol.* 53: 259-269, March 1945.

The first recognizable change in the size of the heart due to mitral valve disease is enlargement of the left auricle, which may occur before the other chambers are affected. Teleroentgenographic mensuration, which is the most frequently used procedure for determining cardiac enlargement, does not take into consideration the fact that posterior enlargement of the left auricle may occur without altering the frontal silhouette of the heart.

The author reports a study of 40 patients with early but indisputable mitral valve disease. Each patient was examined roentgenoscopically, by means of postero-anterior teleroentgenograms and right anterior oblique views made after swallowing a bolus of barium paste. The normal right anterior oblique roentgenogram of the esophagus presents a straight opaque line posterior to the cardiac shadow. Early left auricular enlargement usually results in an indentation into the anterior aspect of the barium column at the proper level. This indentation persists during deep inspiration.

Twenty-one patients had known histories of rheumatic fever and 7 had histories which were suspicious of rheumatic fever. In four patients there was recession of the murmurs so that at one time or another the clinical diagnosis had been changed to functional heart murmurs. There is little doubt that the mitral lesions in these individuals were persistent even though the clinical signs varied. All 40 patients had visibly enlarged left auricles as indicated by posterior deviation of the barium-filled esophagus in the right anterior oblique projection. There were no other signs of left auricular dilatation. Straightening of the second left cardiac border occurred occasionally, but the characteristic "mitral heart" deformity was conspicuous by its absence.

It is concluded that if teleroentgenograms alone are used for roentgen examination in doubtful cases, avoidable errors may occur. Prediction tables based on height and weight, the ratio of the heart rectangle to the lung rectangle, and the relationship of the apex to the left midclavicular line did not prove reliable in the diagnosis of early mitral valve disease in this group of patients. Mitral valve disease may exist for a long time without increase in the size of the heart other than left auricular dilatation.

CLARENCE E. WEAVER, M.D.

THE DIGESTIVE SYSTEM

Gastrointestinal Disorders Simulating Circulatory Disease and Vice Versa. Franz M. Groedel. *Am. J. Digest. Dis.* 12: 73-79, March 1945.

In the diagnosis of cardiac and gastro-intestinal disorders the origin of certain pathologic signs, particu-

larly pain sensations, is often difficult to determine. It is dangerous to make a diagnosis by hard and fast rules without taking account of the variations that may occur because (1) both regions may be diseased simultaneously, (2) gastro-intestinal disease may simulate heart disease and vice versa, (3) a disease of the circulatory system may be concealed by the gastro-intestinal symptoms.

The author does not feel that the incidence of gastro-intestinal disease is higher in cardiac cases than among other patients. He believes that if, for example, coronary thrombosis and gastro-intestinal ulceration occur simultaneously, the underlying cause may be the same, a disturbance of the autonomic nervous system that may result in poor blood supply, which in turn may cause organic disturbance.

Because there are paths of reflex radiation between abdominal and circulatory systems, all cardiac symptoms can be caused or simulated by gastro-intestinal disease and many gastro-intestinal and liver disorders may simulate cardiac lesions. Frequently it is necessary to x-ray the gastro-intestinal tract to rule out its involvement.

A number of case histories are given illustrating conditions where the differential diagnosis between cardiac and gastro-intestinal disease was made only after extensive study. JOSEPH T. DANZER, M.D.

Gastric and Duodenal Ulcers in Infancy and in Childhood. Edward J. Donovan and Thomas V. Santulli. *Am. J. Dis. Child.* 69: 176-179, March 1945.

Ten cases of gastric and duodenal ulcer in infants and in children under thirteen years of age, encountered at the Babies Hospital, New York, from 1930 to 1944, are reviewed. Although gastric and duodenal ulceration is rare in infancy and childhood, the diagnosis would probably be made more frequently if it were realized that the condition does occur in this age group. Peptic ulcer should be suspected in all cases of indefinite abdominal pain in children, particularly if the pain is epigastric. Roentgenologic studies may reveal the lesion, but it is not so easily demonstrated as in adults. Hemorrhage is the most common complication, occurring in 6 of the 10 cases reported. Perforation and pyloric stenosis were also observed.

Gastric Schwannoma: Report of a Large Intragastic Lesion Simulating a Bezoar. Julio Sanguily and Francisco Leon Blanco. *Surgery* 17: 328-336, March 1945.

The type of tumor here described is known in the medical literature by many names following the different microscopic aspects which it may present and the different conceptions of its nature. Penfield, considering it of connective-tissue origin, calls it perineural fibroblastoma; Verocay designates it neurinoma; the type due to Schwann's cells is called schwannoma or lemmoma; others consider it a peripheric glioma.

The authors' patient was a 58-year-old Negro woman with digestive complaints and a mobile epigastric mass. Roentgen examination demonstrated a foreign body occupying the whole gastric cavity, resembling a bezoar, and exploration was undertaken. This revealed a large solid tumor occupying the entire gastric cavity and attached by a pedicle to the posterior wall of the fundus. The tumor had assumed the shape of the stomach. Operative removal was successful and a histologic diagnosis of schwannoma was made.

J. E. WHITELEATHER, M.D.

Roentgenologic Examination of the Stomach with Patient Under Sodium Pentothal Anesthesia. H. E. Plenge and J. N. Ross. *Southern M. J.* 38: 183-185, March 1945.

Three cases came to the authors' attention, in which a constant deformity of the pylorus, as shown on the roentgenogram, led to a diagnosis of cancer, but no lesion was found at operation. Apparently in each instance the stomach had been subject to continuous spastic deformity which disappeared following the induction of anesthesia.

The authors' own case is that of a 54-year-old man who had persistent epigastric distress and occasional vomiting. Roentgen study showed an apparently massive fixed lesion of the pylorus with a large crater on the lesser curvature. A subsequent examination, following administration of belladonna, produced an identical picture. A third roentgen examination, carried out quickly under anesthesia produced by a small intravenous dose of "sodium pentothal," revealed relaxation of a previously narrowed portion of the original deformity, which apparently resulted from spasm. The procedure is advocated as a simple measure in certain doubtful cases, in which it may prevent unnecessary surgery.

MAX MASS, M.D.

Orientation of the Gastroscope by Roentgenograms. A. Ray Hufford and G. G. Stonehouse. *Am. J. Digest. Dis.* 12: 61-64, March 1945.

In order to show what actually happens to the gastroscope and to anatomical structures through which it passes, the authors made a radiographic study of two patients during gastroscopy. In neither was there any roentgen or gastroscopic evidence of disease of the esophagus, stomach, or duodenum. The position of the gastroscope was visualized by impregnating its rubber tip with sufficient barium to make it densely radiopaque.

The greatest degree of flexion of the gastroscope occurred in the lower end of the esophagus, where the tip flexed acutely to the left and forward as it passed into the cardia. The normal angulation of the esophagus was almost completely eradicated by the flexible shaft of the gastroscope, but in compensation the shaft was flexed about five degrees. After the scope passed the cardia, air was injected and the tube passed down to the lower end of the stomach, where the tip flexed at an acute angle to conform with the contour at the greater curvature. The blind spots or areas in the gastric wall were shown to be those parts which are in contact with or short of the focusing distance from the objective or inclined away from the objective at such an oblique angle that only a darkened area can be seen.

A study of the x-rays taken convinced the authors that the gastroscope is sufficiently flexible to pass through normal channels without any undue stress or strain on them. The tip can be passed by sight until it rests in the lower pole of the stomach, which adjusts itself to the slightest pressure of the scope.

JOSEPH T. DANZER, M.D.

The Gall Bladder in Patients with Pernicious Anemia: A Study of Non-Visualization and Rate of Emptying. Edward A. Boyden and John A. Layne. *Gastroenterology* 4: 121-134, February 1945.

Cholecystographic studies were made of 48 unselected patients with pernicious anemia (23 males and 25 females) seen in the University of Minnesota Hospitals. All but 2 of the patients were receiving treatment with

liver extract at the time of the study, and the hemoglobin and erythrocyte levels had either reached normal or were responding to treatment. Examination of the gastric contents, following subcutaneous administration of histamine phosphate, showed complete absence of free hydrochloric acid in all cases, and only minimal amounts of total acids.

The following technic was employed. On the evening preceding examination, "isoiodeikon," in a sterile solution of physiological saline, was injected intravenously—40 mg. per kg. of body weight—the maximum dose for any one patient being 2.5 gm. Subsequent to the demonstration of the gallbladder shadow, films were taken at 0, 2, 4, 8, 12, 16, 20, 25, 30, 35, 40, and 45 minutes after the fat meal. The outlines of the gallbladder were then transferred to tracing paper and divided into segments representing circular plinths. From these the changing volumes of the gallbladder were computed.

In 8 of the 23 males (35 per cent) and in 12 of the females (48 per cent) no gallbladder shadow was demonstrable. In the male patients in whom the shadow was demonstrated, the curve of evacuation was not significantly different from that of the controls. In the women, there was a highly significant retardation, only 65 per cent of the gallbladder contents having been discharged in the first forty minutes after the standard fat meal as against 84 per cent in the controls. Most of the women in this series had borne children. The greater susceptibility of the female group of patients may be attributed to the double insult sustained by the gallbladder—the stasis induced by pregnancy and the superimposed stasis induced by pernicious anemia. Twenty-seven per cent of the entire group from which curves of evacuation were obtained showed a reflux of cystic bile into the common hepatic duct. This indicates that in some cases there is a permanent narrowing of the choledochoduodenal junction, independent of the condition of the gallbladder wall.

An analysis of the 105 cases of pernicious anemia in 31,311 consecutive necropsies at the University of Minnesota Hospitals revealed that 32 per cent of the group had had cholecystitis or cholelithiasis (or both), or the gallbladder had been removed. This study showed an increasing incidence of gallbladder disease with age, ranging from 16 per cent in the fifth decade to 50 per cent in the eighth. In the authors' group a similar progression occurs. Since the greatest incidence in the general population is in the fifth decade, these observations suggest that pernicious anemia and gallbladder disease have an etiological relationship.

Since all but two of the patients had been given liver extract before the cholecystographic studies, no correlation could be shown between the visualized and non-visualized groups either in respect to duration of the pernicious anemia, duration of treatment, or response to treatment. It is suggested that damage to the biliary duct system occurs in the early stages of anemia.

The occurrence of a normal rate of emptying of the gallbladder in the males in whom the organ was visualized, notwithstanding the complete absence of free acid in the stomach, indicates that free hydrochloric acid is not essential to evacuation of the biliary vesicle.

Aberrant Pancreatic Tissue as a Roentgenologic Problem. George J. Baylin. *Am. J. Roentgenol.* 53: 277-280, March 1945.

The close embryological relationship of the duodenum and pancreas, with the latter originating as buds

from the former, makes it easy to understand why there are small clumps of pancreatic tissue frequently embedded in the duodenum and other portions of the intestinal tract. Two cases are described. In one there was an ampullary defect in the duodenum which was diagnosed roentgenologically as a carcinoma. The patient was jaundiced. At operation a cluster of aberrant pancreatic tissue was found near the papilla. This was not causing obstruction and there was no lesion in the head of the pancreas. At autopsy, an extensive inflammatory process of the liver was found which accounted for the obstructive jaundice. The other patient had an annular constriction of the second portion of the duodenum. This was correctly diagnosed as circular constriction of the duodenum by aberrant pancreatic tissue. In every instance of a persistent narrowing in the size of the lumen of the second portion of the duodenum the diagnosis of aberrant pancreatic tissue must be considered. This may produce obstructive symptoms in the presence of pancreatitis.

CLARENCE E. WEAVER, M.D.

THE ADRENALS

Hormonal Tumors of the Adrenal. George F. Cahill. *Surgery* 16: 233-265, August 1944.

This comprehensive discussion of adrenal tumors opens with a review of the development of the adrenals. It is well established that these glands elaborate androgens and estrogens, as well as other metabolic hormonal steroids, and that these hormones may be present in excess amounts in tumors of the adrenal cortex. The symptoms of such tumors vary according to the hormone secreted, its amount, and the age and sex of the patient. The following clinical classification is repeated from an earlier paper (Cahill, Melicow, and Darby: *Surg., Gynec. & Obst.* 74: 281, 1942).

1. No recognizable hormonal change.
2. Changes due to excess androgens.
 - (a) In female child toward adult masculinity.
 - (b) In female adult toward masculinity.
 - (c) In male child toward adult masculinity.
3. Changes due to excess estrogens.
 - (a) In adult male toward femininity.
4. Changes due to excess androgens and other steroids.
 - (a) Cushing's syndrome with associated sexual changes (mostly in females).
5. Changes due to excess of other steroids related to metabolism.
 - (a) Cushing's syndrome without sexual changes (in male and female).

Each of these groups except the first is taken up in detail, with references to the literature and to cases recorded in the paper cited above.

Syndromes suggestive of adrenal changes are only in rare instances of neoplastic origin. Once the presence of high levels of androgens or estrogens in the urine has been established, x-ray studies with the aid of air insufflation into the perirenal fascial spaces will determine the presence or absence of a tumor. [See the author's paper on this subject in *Radiology* 37: 533, 1941.] The tumors are round when small, ovoid when larger, and may be lobulated when very large. Air insufflation is of special value when the tumor is small and unrecognizable by any other method except operation.

The sole hormone-producing tumor of the adrenal medulla is the pheochromocytoma, known also as para-

ganglioma and chromaffinoma. The only known secretion of the pheochromocytoma cell is epinephrine, and the symptoms of pheochromocytoma are those of paroxysmal hypertension, due to excess pressor substance in the blood. The diagnosis of these medullary tumors depends upon the characteristic hypertensive attacks, the demonstration of the pressor substance in the blood, and air insufflation studies.

The author describes the therapeutic management of both cortical and medullary adrenal tumors. Removal of cortical adenomas produces a cure, though fixed changes may persist. Even if the tumor proves to be a carcinoma, some amelioration of symptoms may follow operation. Acute adrenal deficiency incident to removal is to be treated like the acute crises of Addison's disease, with potent adrenal hormone. Medullary tumors are for the most part benign, and if the patient survives the operation and immediate postoperative period, the prognosis following removal is favorable. The collapse subsequent to operation may be combated by adrenalin, adrenal cortical hormone, or intravenous saline. Nine cases of pheochromocytoma are briefly reported.

J. E. WHITELEATHER, M.D.

THE MUSCULOSKELETAL SYSTEM

Bone Regeneration Following Osteomyelitis. Laurence H. Mayers. *Surgery* 17: 463-471, March 1945.

The processes of bone destruction and bone restoration in an osteomyelitis of the phalanges of a finger go on almost simultaneously. An illustrative case is reported, in a policeman who was bitten on the middle finger of the left hand. Pyogenic organisms, spirilla, and anaerobes were all present as the case progressed. Although the patient was forty years old, far beyond the age at which bone restoration is regarded as assured, the amount of regeneration is surprising and interesting.

The day after the wound was received, the finger was incised below the nail, liberating a quantity of foul, purulent material. The early film showed very little destructive change, but six days later a definite osteomyelitic process with rapid extension was apparent. Twelve days later there was almost complete dissolution of the middle portion of the phalanx with moderately advanced invasion of the distal three-fourths of the middle phalanx and involvement of the distal joint.

The treatment covered the conventional range. Sequestration was observed twenty-two days after the injury and indicated the first effort at restoration of the destroyed bone. Four days later there was further invasion toward the middle joint with increasing destruction of the distal phalangeal bone; sequestered fragments of bone were visible as evidence of the conflict between living and dead cells. In another seven days films showed progression of the osteomyelitis but diminution of the edema. Five weeks after the wound was received the finger was reoperated upon. A small amount of necrotic tissue was removed, and the flexor tendon was exposed and found to be destroyed distal to the proximal and middle phalanx. Three weeks later improvement in the bone of the distal phalanx was evident roentgenographically, although there was some further invasion of the middle and proximal phalanges and the periosteum was stripped in the middle portion. Eventually the osteomyelitic process abated and the cortex reappeared.

A series of x-ray films is reproduced permitting one to

trace the course of this virulent infection, resulting in a destructive and progressive osteomyelitis, from the beginning to the final climax of bone restoration.

J. E. WHITELEATHER, M.D.

Solitary Eosinophilic Granuloma of Bone. Benjamin B. Greenberg and Albert J. Schein. *Am. J. Surg.* 67: 547-555, March 1945.

Two new cases of solitary eosinophilic granuloma, one involving the clavicle and the other the tibia, are presented. Neither case was diagnosed preoperatively. In the one case, roentgen studies showed an irregular expansion of the shaft of the lateral third of the clavicle. Bony trabeculae extended throughout a bony defect in the expanded area. The lesion was about 5 cm. long. At several points, the cortex had been completely eroded. There was a moderate amount of periosteal new bone formation extending mesially from the bony lesion along the shaft of the clavicle. A tentative diagnosis of primary bone tumor was made, with the most likely possibilities giant-cell tumor, chondroma, and chondrosarcoma. In the second case, x-ray examination showed a destructive lesion involving the proximal third of the shaft of the tibia. The lesion had eroded the anterior cortex and invaded the medullary cavity as far as the endosteal zone of the posterior cortex. It had also extended laterally in either direction. It had produced a periosteal reaction mostly on its medial but also in its anterolateral aspect. The destructive zone extended almost to the epiphyseal line in the diaphysis and was eccentrically placed. The original tibia outline showed no expansion. Diagnostic suggestions were Ewing's tumor and osteomyelitis. The diagnosis of eosinophilic granuloma in each case was made only on pathologic study of excised material. Roentgen therapy, in small doses, was administered postoperatively in both instances. Both patients were well at the time of the report.

Although pathological examination is essential for the diagnosis of doubtful or obscure bone lesions, the authors believe that x-ray films may suggest eosinophilic granuloma before biopsy if the lesion is borne in mind.

Roentgen Diagnosis of Traumatic Lesions of the Cervical Spine. Gilbert W. Heublein. *J. A. M. A.* 126: 950-954, Dec. 9, 1944.

Basing his presentation upon experience gained in a large Army General Hospital, the author discusses the importance of roentgenologic methods in dealing with cervical spine injuries. Concise case reports are used to illustrate various points.

Among the confusing shadows which may at times mimic fractures of the cervical spine are extra ossification centers, areas of incomplete fusion, superimposed teeth shadows, sesamoids in the ligamentum nuchae, and limbus vertebrae. Fractures at the base of the odontoid process may not be evident on initial examination, but may show up weeks later as rarefying osteitis along the fracture line. Pathologic fractures in the cervical spine are rare. Rotary dislocation of the atlas on the axis may be the result of structural weakness, uncomplicated trauma, or an inflammatory process in adjacent cervical soft tissues.

Technic is extremely important. The conventional anteroposterior and lateral projections should be supplemented at times with open-mouth views, the Jackson projection, lateral films made in flexion and extension, laminagraphy, and myelography.

It is emphasized that the success of myelography depends upon employing proper apparatus, accurate spinal puncture by an experienced neurosurgeon, adequate extension of the neck, post-myelographic withdrawal of the opaque medium and, finally, careful correlation of clinical and roentgenologic findings.

JOHN F. HOLT, M.D.
(University of Michigan)

Cleidocranial Dysostosis—Report of Case. Fred G. Repass. *Virginia M. Monthly* 72: 121-124, March 1945.

A case of cleidocranial dysostosis is presented with special reference to the dental aspects. A woman, twenty-nine years of age, was referred by her dentist to the author, a dental surgeon, for removal of the teeth, including several which were unerupted and impacted. She has been wearing an upper denture for fifteen years and a partial lower denture for ten, because so few permanent teeth had ever erupted.

The patient was small of stature (49 inches) and gracefully built, as are most of those with this condition. There was moderate bulging of the forehead with prominent bosses. The maxilla was small and underdeveloped with a high furrowed V-shaped palate. The lower jaw was prognathous.

Dental films revealed twenty-six unerupted and impacted teeth lying in irregular arrangement. In the upper and lower anterior regions these appeared to be in clusters, some being inverted. Roentgen examination of the skeleton showed absence of the left clavicle except for a small stump 2.5 cm. in length at the sternal end; the two ends of the right clavicle had never fused. There was a spina bifida occulta of the first and second dorsal vertebrae. The skull was brachycephalic with a prominent lower jaw, the frontal sinuses were small and the mastoids undeveloped. Numerous small wormian bones appeared along the suture lines, and a metopic suture in the frontal bone.

The patient's mother showed a similar condition, but her sister was normal, and a 3-year-old son as yet showed no evidence of the disease.

In a discussion of the dental problems involved in these cases, the author states that extraction of the deciduous teeth does not aid in the eruption of the permanent teeth and is contraindicated; instead, the deciduous teeth should be given the utmost care. If they are lost, they should be replaced by prosthetic appliances even though the edentulous areas contain many unerupted teeth. The removal of an occasional unerupted tooth may be necessary. Orthodontic treatment appears to be of no avail; occasionally bilateral osteotomy may have to be performed to correct the prognathous condition of the lower jaw.

J. E. WHITELEATHER, M.D.

A Case of the Klippel-Feil Syndrome (Congenital Synostosis of the Cervical Vertebrae). Roald Rinvik. *Acta paediat.* 31: 417-427, June 30, 1944. (In English.)

A case of synostosis of the cervical vertebrae associated with spina bifida in a young child is reported. An unusual feature of the case was an extensive occipital spina bifida. Roentgen examination revealed a cleft in the pelvis of the right kidney, but no evidence of a double ureter could be found. Certain peculiar subcutaneous alterations of the chin and fingers were also present.

Spondylolisthesis: A Commentary on Etiology, and an Improved Method of Roentgenographic Mensuration and Detection of Instability. Isadore Meschan. *Am. J. Roentgenol.* 53: 230-243, March 1945.

The essential underlying predisposing factor in spondylolisthesis is the bilateral defect in the pars interarticularis of the neural arch. This is thought to be due to a failure in ossification similar to that found in spina bifida. There are some who favor a completely traumatic origin for the disease. It is believed the trauma may occur very early in life—during delivery or early in the post-natal period. Whether or not the original defect is developmental or traumatic, there is evidence that trauma, even of minor degree, may widen the defect, initiate symptoms, and even start the displacement. In the rigorous training of soldiers, the development of spondylolisthesis is a definite possibility. The disease cannot be dismissed lightly as a congenital anomaly.

For mensuration of spondylolisthesis the author draws lines on the lateral roentgenogram as follows: (1) from the posterior lower lip of the vertebral body above the one involved, to the posterior upper lip of the body below; (2) between the posterior upper and lower lips of the slipped vertebral body. The lines are extended, if they are not parallel, so that they meet and form a measurable angle. The apex of the angle always falls above the body in question. If the lines should be parallel, the distance between them is 4 mm. or more. Angles up to 10 degrees can be called slight, 11 to 20 degrees moderate, and greater than 20 degrees severe. The displacement of the vertebral body is seldom linear. This method also furnishes a means of measuring accurately any change which occurs in weight bearing, flexion, and extension by comparison of the measured angle on roentgenograms made under these conditions.

In an Army General Hospital 57 cases of defect of the pars interarticularis (5.1 per cent) were found in a total of 1,131 lumbosacral spine examinations; 41 showed spondylolisthesis, in 37 cases involving the fifth lumbar vertebral body.

The displaced vertebral body may or may not be stable. In 7 of the 41 cases of spondylolisthesis in the present series it was found to be unstable; in 4 of these this could be demonstrated by comparison of the recumbent with the weight-bearing (standing) neutral roentgenogram; 3 cases revealed instability only after a roentgenogram in hyperextension was compared with the other views. The value of the oblique roentgenogram of the lumbosacral spine for demonstration of defects of the pars interarticularis is emphasized.

CLARENCE E. WEAVER, M.D.

Isthmus Defects of the Fifth Lumbar Vertebra. R. Beverly Raney. *Southern M. J.* 38: 166-174, March 1945.

The condition designated variously as bilateral isthmus defect (*i.e.*, lack of bony continuity in the pars interarticularis), prespondylolisthesis, spondylolysis, and spondyloschisis is believed to be responsible for many cases of low-back pain even in the absence of vertebral displacement. The defect divides the vertebra into two separate parts and leaves the stability of the spine dependent solely upon the supporting ligaments.

The incidence of isthmus defects (bilateral and unilateral), as based on an anatomical study of over a thousand skeletons, is in the neighborhood of 5 per cent.

Figures based on roentgen studies vary. The author found defects demonstrable in the oblique roentgenogram in 94 of 300 patients (*i.e.*, 31 per cent) examined because of low-back pain. In about 70 per cent the defect was bilateral. The fifth lumbar vertebra was involved in 92 patients (97 per cent of the positive cases). In 2 cases the fourth lumbar vertebra was also affected and in 2 cases it alone was involved.

The author presents the pathologist's report on a part of a defective isthmus removed for biopsy from one of his patients. The opposing margins were made up of compact bone covered with hyaline cartilage, while fibrillar connective tissue containing few cartilage cells completely bridged the gap.

The preponderance of opinion seems to indicate that these defects are probably a developmental anomaly; however, some believe they may be due to birth trauma. Symptoms are predominantly low-back pain aggravated by increased mechanical stress and relieved by immobilization, radiating pain along nerve distribution in the lower extremities, and limitation of motion and tenderness in the back muscles. The diagnosis is almost entirely dependent on a careful roentgenographic study.

The oblique projection taken with the patient supine, but with one side of the body so raised that its transverse axis lies at an angle of approximately 45° to the table and film, demonstrated, every case in this series. Only 18 per cent of the positive cases could be demonstrated in the anterior view and only 20 per cent in the lateral view.

Conservative treatment is advised, consisting of splinting and immobilization. When these measures are ineffective, lumbosacral spinal fusion is indicated.

In the discussion of this paper, Dickson, of Kansas City, stated that 70 per cent of cases of low back pain treated surgically in his clinic were due to instability of the lumbosacral region and 30 per cent to protruded disks. Sixty per cent of the cases of faulty architecture were due to isthmus defects. Dr. Dickson places greatest reliance on the lateral roentgenogram taken in acute flexion and extension. Dr. McCarroll of St. Louis stated that all isthmus defects coming to operation should also be explored for possible disk protrusion. Many roentgenographic illustrations are included. A bibliography is appended.

MAX MASS, M.D.

Calcification of the Intervertebral Discs in Childhood. H. Stephen Weens. *J. Pediat.* 26: 178-188, February 1945.

A 5-year-old girl was admitted to the hospital with severe pain in the back of the neck. This acute episode was preceded by slight aching in the back of the neck of two months' duration. The patient had had frequent attacks of tonsillitis, otitis media, and ascariasis. Her temperature on admission was 100° F. Physical examination showed a rather conspicuous hyperextension of the neck. Slight passive rotation of the head was possible, but flexion could not be carried out. The child walked with stooped shoulders and marked kyphosis of the dorsal spine. The temperature returned to normal in two days, without treatment. Two days later all pain had disappeared and the patient was discharged twelve days after admission free of symptoms. There was no residual deformity of the spine, and movement of the head and neck was not restricted.

Roentgen studies, including fluoroscopy, at the time of admission revealed a dense, flocculent, cone-shaped

trace the course of this virulent infection, resulting in a destructive and progressive osteomyelitis, from the beginning to the final climax of bone restoration.

J. E. WHITELEATHER, M.D.

Solitary Eosinophilic Granuloma of Bone. Benjamin B. Greenberg and Albert J. Schein. *Am. J. Surg.* 67: 547-555, March 1945.

Two new cases of solitary eosinophilic granuloma, one involving the clavicle and the other the tibia, are presented. Neither case was diagnosed preoperatively. In the one case, roentgen studies showed an irregular expansion of the shaft of the lateral third of the clavicle. Bony trabeculae extended throughout a bony defect in the expanded area. The lesion was about 5 cm. long. At several points, the cortex had been completely eroded. There was a moderate amount of periosteal new bone formation extending medially from the bony lesion along the shaft of the clavicle. A tentative diagnosis of primary bone tumor was made, with the most likely possibilities giant-cell tumor, chondroma, and chondrosarcoma. In the second case, x-ray examination showed a destructive lesion involving the proximal third of the shaft of the tibia. The lesion had eroded the anterior cortex and invaded the medullary cavity as far as the endosteal zone of the posterior cortex. It had also extended laterally in either direction. It had produced a periosteal reaction mostly on its medial but also in its anterolateral aspect. The destructive zone extended almost to the epiphyseal line in the diaphysis and was eccentrically placed. The original tibia outline showed no expansion. Diagnostic suggestions were Ewing's tumor and osteomyelitis. The diagnosis of eosinophilic granuloma in each case was made only on pathologic study of excised material. Roentgen therapy, in small doses, was administered postoperatively in both instances. Both patients were well at the time of the report.

Although pathological examination is essential for the diagnosis of doubtful or obscure bone lesions, the authors believe that x-ray films may suggest eosinophilic granuloma before biopsy if the lesion is borne in mind.

Roentgen Diagnosis of Traumatic Lesions of the Cervical Spine. Gilbert W. Heublein. *J. A. M. A.* 126: 950-954, Dec. 9, 1944.

Basing his presentation upon experience gained in a large Army General Hospital, the author discusses the importance of roentgenologic methods in dealing with cervical spine injuries. Concise case reports are used to illustrate various points.

Among the confusing shadows which may at times mimic fractures of the cervical spine are extra ossification centers, areas of incomplete fusion, superimposed teeth shadows, sesamoids in the ligamentum nuchae, and limbus vertebrae. Fractures at the base of the odontoid process may not be evident on initial examination, but may show up weeks later as rarefying osteitis along the fracture line. Pathologic fractures in the cervical spine are rare. Rotary dislocation of the atlas on the axis may be the result of structural weakness, uncomplicated trauma, or an inflammatory process in adjacent cervical soft tissues.

Technic is extremely important. The conventional anteroposterior and lateral projections should be supplemented at times with open-mouth views, the Jackson projection, lateral films made in flexion and extension, laminagraphy, and myelography.

It is emphasized that the success of myelography depends upon employing proper apparatus, accurate spinal puncture by an experienced neurosurgeon, adequate extension of the neck, post-myelographic withdrawal of the opaque medium and, finally, careful correlation of clinical and roentgenologic findings.

JOHN F. HOLT, M.D.
(University of Michigan)

Cleidocranial Dysostosis—Report of Case. Fred C. Repass. *Virginia M. Monthly* 72: 121-124, March 1945.

A case of cleidocranial dysostosis is presented with special reference to the dental aspects. A woman twenty-nine was referred by her dentist to the author, a dental surgeon, for removal of the teeth, including several which were unerupted and impacted. She has been wearing an upper denture for fifteen years and a partial lower denture for ten, because so few permanent teeth had ever erupted.

The patient was small of stature (49 inches) and gracefully built, as are most of those with this condition. There was moderate bulging of the forehead with prominent bosses. The maxilla was small and undeveloped with a high furrowed V-shaped palate. The lower jaw was prognathous.

Dental films revealed twenty-six unerupted and impacted teeth lying in irregular arrangement. In the upper and lower anterior regions these appeared to be in clusters, some being inverted. Roentgen examination of the skeleton showed absence of the left clavicle except for a small stump 2.5 cm. in length at the sternum; the two ends of the right clavicle had never fused. There was a spina bifida occulta of the first and second dorsal vertebrae. The skull was brachycephalic with a prominent lower jaw, the frontal sinuses were small and the mastoids undeveloped. Numerous small wormian bones appeared along the suture lines, and a metopic suture in the frontal bone.

The patient's mother showed a similar condition, a sister was normal, and a 3-year-old son as yet showed no evidence of the disease.

In a discussion of the dental problems involved in these cases, the author states that extraction of the deciduous teeth does not aid in the eruption of the permanent teeth and is contraindicated; instead, the deciduous teeth should be given the utmost care. If they are lost, they should be replaced by prosthetic appliances even though the edentulous areas contain many unerupted teeth. The removal of an occasional unerupted tooth may be necessary. Orthodontic treatment appears to be of no avail; occasionally bilateral osteotomy may have to be performed to correct the prognathous condition of the lower jaw.

J. E. WHITELEATHER, M.D.

A Case of the Klippel-Feil Syndrome (Congenital Synostosis of the Cervical Vertebrae). Roald Rinvik. *Acta paediat.* 31: 417-427, June 30, 1944. (In English.)

A case of synostosis of the cervical vertebrae associated with spina bifida in a young child is reported. An unusual feature of the case was an extensive occipital spina bifida. Roentgen examination revealed a cleft in the pelvis of the right kidney, but no evidence of a double ureter could be found. Certain peculiar subcutaneous alterations of the chin and fingers were also present.

1. Axillary dislocation through rupture of the inferior part of the joint capsule.
2. Fracture of the greater tuberosity by the shearing effect of the upper rim of the glenoid complicating the dislocation.
3. Fracture of the head plus dislocation because of extreme force.
4. Typical "three-fragment fracture" produced when the capsule does not give way, causing the traumatic force to disengage the shaft away from the head in a curved line of cleavage and the greater tuberosity to be sheared off. These fragments are usually not impacted. Manipulation or the use of an airplane splint tends to shift the fragments out of alignment. Recommended treatment, therefore, consists of adduction and the use of a sling to allow early motion and to permit the weight of the arm to act as its own traction. Complications are usually due to unnecessary manipulation producing uncontrollable rotation of the head and tuberculum. This usually requires open reduction. The tuberculum fragment occasionally invaginates the subdeltoid bursa as it retracts upward and so may not be readily seen at operation.

The anteroposterior projection is adequate to determine the extent of damage and displacement. The lateral view gives no added information and is contraindicated, since the necessary abduction would produce pain and jeopardize the alignment of the fragments.

The *dorsal mechanism* is produced by extending the arm to break a backward fall. The maximum dorsal elevation of the arm is reached when the humerus locks against the spine of the scapula at the acromion. Continued force either pushes the head through the joint capsule, dissecting the subscapularis from its scapular attachment, resulting in anterior dislocation, or a fracture occurs, leaving the head in the joint with an upward impaction of the shaft resulting in posterior angulation and producing the "two-fragment fracture."

In this fracture, x-ray examination must include the lateral projection to determine the degree of posterior angulation and the treatment. The impaction permits this view to be made without increase of pain and with little danger of altering the fragment position. Manipulation and traction under anesthesia are indicated to reduce a strongly impacted or markedly angulated fracture and in the rare instance of fracture with complete loss of contact between the head and the shaft. After reduction, a sling or hanging cast is utilized.

The dislocation resulting from the dorsal fracture mechanism, unlike the lateral mechanism dislocation, is usually recurrent. A minor reason for this is that the motion of posterior trauma occurs routinely, as in putting on a heavy coat or by the arm hanging over the edge of the bed while the patient is asleep. The major reason lies in the pathologic structure of the joint following the injury. Investigation showed that the anterior part of the limbus glenoidalis was usually torn loose, hung free, and was dislocated posteriorly; that the anterior rim of the glenoid fossa was rough and denuded of cartilage; and that the subscapularis, deprived of an essential part of its attachment, was thinned out and relaxed. Correction by open reduction is required.

In the *central mechanism*, the head is driven against the glenoid fossa. Injury of the fossa is rare and usually occurs in younger people with strong bone. There is ordinarily complete return of function, with no specific treatment required.

The anteroposterior roentgenogram only is needed in this mechanism. In the so-called "headsplitting fracture," the short horizontal diameter of the glenoid contacts a small sector of the humeral head, giving a characteristic picture. In older people with considerable bone atrophy, the head is shattered into many fragments. This frequently leads to deformity due to destruction of cartilage and resorption of bone.

LESTER M. J. FREEDMAN, M.D.

Conservative Management of Adolescent Slipping of the Capital Femoral Epiphysis. Robert Dunham Moore. *Surg., Gynec. & Obst.* 80:324-332, March 1945.

Forty-four cases in which slipping of the capital femoral epiphysis was treated conservatively are reviewed, with evaluation of the results. The case for conservative management is based on (1) the many unsatisfactory results following currently popular methods of treatment; (2) the belief that the risk of damage to the blood supply of the epiphysis by operation outweighs the disadvantage of the longer disability period necessitated by conservative treatment; (3) the lack of proof that accurate replacement is necessary in cases of moderate deformity, coupled with the difficulty of manipulative replacement when the rate of slippage is slow; (4) the danger of infarction of the epiphysis in operative procedures; (5) the minimum of trauma to the soft parts about the hip as well as the blood supply.

The cases reviewed are divided into three groups showing minimal, moderate, and complete separation, respectively. The results are based on examinations after two to six years.

In Group I, showing minimal displacement, 26 hips were treated by immobilization in plaster with the leg in abduction and internal rotation. This was continued for from three to nine months, until ossification of the capital epiphyseal growth cartilage took place. The results were good in 88.5 per cent, poor in 3.8 per cent, uncertain (no follow-up) in 7.7 per cent.

In Group II, showing moderate displacement, 23 hips were treated by the same general principles, with immobilization for eight weeks to seven months. The results were good in 47.8 per cent, fair in 13 per cent, poor in 21.7 per cent, uncertain in 17.5 per cent.

In Group III, showing complete separation, there were 3 cases. One case, treated by traction and cast, gave good reposition and end-result (33.3 per cent). In the second case traction did not correct the deformity and necrosis of the epiphysis occurred. The third case showed necrosis of the head on admission, and excision of the head and arthrodesis of the hip were done.

Long-term evaluation with reference to traumatic arthritis awaits follow-up studies.

J. L. BOYER, M.D.

Fatigue Fracture of the Fibula. Report on Two Cases. David A. Richmond. *Lancet* 1:273, March 3, 1945.

Two cases of fracture of the fibula are reported, showing all the features described by Blair Hartley (*Brit. J. Radiol.* 16:255, 1943. *Abst. in Radiology* 43:309, 1944) as characteristic of fatigue fractures.

Pathology of the Anomalies Found in Knee Joints. Samuel Harold Nickerson. *Am. J. Roentgenol.* 53:213-229, March 1945.

The embryology of the patella and the literature concerning its phylogenetic development and signifi-

cance in the light of comparative anatomy are reviewed, and the following facts, among others, emerge. The close anatomical relationship between the patella and quadriceps muscle mass has been demonstrated (Walmsley: *J. Anat.* 74: 360, 1940). The important dynamic interdependence of the developing patella and quadriceps muscle has been shown experimentally (Carey: *Radiology* 10: 234, 1928). The priority of development of the medial components of the knee joint has been embryologically substantiated (Langer: *Ztschr. f. d. ges. Anat., Abt. 1*, 89: 83-101, 1929). The embryonic patella develops a larger lateral and smaller medial articular surface. The entire patella is undergoing a slow and gradual development erasure (de Vriese: *Anat. Anz.*, 1908, 32, *Erganzungsheft*, 163).

Two cases are reported by the author in which there was absence of the medial half of the patella in each knee. The medial synovial compartment was underdeveloped, and there was incomplete vertical septation of the synovial cavity. The first patient also exhibited poor development of the thumb nails. The basic pathology has been described as being due to aberrant or pathological linked genes which possess abnormal mesodermal and ectodermal characteristics. This explains the presence of both ectodermal and mesodermal anomalies in the same individual. The primary developmental aberration due to the pathological gene is manifested by faulty and incomplete differentiation of the premuscle mesenchymal mass which ordinarily is destined to become a portion of the quadriceps extensor apparatus—the vastus internus. The changes occur in the medial portion of the knee joint and exhibit either hypoplastic or aplastic characteristics. The feeling is expressed that the patella in these cases represents the true bone but is the lateral portion only—a hemidevelopment. The medial portion of the knee joint possesses older phylogenetic structures than its lateral portion. Anomalies of the lateral portion will present themselves in the form of accessory growth such as extra-patellar centers. Anomalies of the medial compartment will present themselves in the form of developmental erasure.

CLARENCE E. WEAVER, M.D.

Skeletal Changes in the Acute Leukoses of Children. Olof Brandberg. *Acta paediat.* 30: 205-211, Dec. 23, 1942. (In German.)

In 3 cases of acute aleukemic lymphadenosis in children of one, three, and seven years, the following bone changes were observed: (1) small disseminated foci of destruction; (2) periosteal elevation, chiefly along the shafts of the long bones; (3) a "clearing zone"—the zone of diminished density described by Baty and Vogt (*Am. J. Roentgenol.* 34: 310, 1935) proximal to the metaphyses of the long bones, adjacent and parallel to the epiphyseal line; a similar zone occurred also along the iliac crest and in the os pubis. The first two changes are due to leukemic infiltration, which, however, is not established in the case of the third.

The author emphasizes the fact that the changes described are not pathognomonic for the leukoses, but they are nevertheless of diagnostic significance.

GYNECOLOGY AND OBSTETRICS

Hysterosalpingography in Sterility. Colin Macdonald. *M. J. Australia* 1: 142-144 Feb. 10, 1945.

Investigation of the patency of the fallopian tubes by the injection of lipiodol under fluoroscopic control

is valuable both from a diagnostic and therapeutic standpoint. Beneficial results are ascribed to (1) clearing the cervical canal and fallopian tubes of mucus and secretions, (2) relief of spasm, either at the internal os or in the uterus or tubes, (3) breaking down of adhesions on either the mucosal or serous side of the tubes, (4) straightening tubal convolutions and kinks and (5) preventing adhesions after a plastic operation on the tubes. Macdonald believes that too often Rubin's test suggests tubal obstruction, while lipiodol shows unequivocally that both tubes are patent.

Contraindications to hysterosalpingography include (1) acute or subacute infections in the vulva, the vagina, the cervix, the fallopian tubes, or the pelvis, (2) uterine hemorrhage, (3) suspected pregnancy, (4) fever from any cause, and (5) severe pulmonary or cardiovascular disease. In order to minimize the possibility of oil embolus, many prefer to make the injection between the eighth and twelfth day after a menstrual period, though others hold that better therapeutic results are obtained if the injection is made the day after cessation of menstruation.

Under fluoroscopic guidance the injection procedure is in three stages. When the patient first complains of suprapubic discomfort, it is found that the uterus is filled but that none has passed into the fallopian tubes. Discomfort passes and the injection is continued. When the patient complains of discomfort again, the tubes are outlined to the fimbriated ends. Discomfort again passes and the third and last injection is made. Routinely, films are made at the completion of each stage and at twenty-four hours.

British and American results are in substantial agreement that when cases of sterility were investigated by this procedure 30 per cent of public hospital patients and over 40 per cent of private patients had subsequently conceived and gone to term.

ELLWOOD W. GODFREY, M.D.

Hysterosalpingography as a Diagnostic Aid in Certain Types of Ruptured Uteri. Joseph B. Sheffery. *Am. J. Obst. & Gynec.* 49: 423-427, March 1945.

A case of ruptured uterus is reported. The classic signs of sudden pain, shock, and prostration were absent. The patient had been delivered five years before of a viable baby by cesarean section. Her present prenatal course had been uneventful until the beginning of the ninth month. At that time, she complained of severe backache. Four hours later, just prior to hospitalization, the pain subsided. The pulse rate, blood pressure, and respiration were normal. That evening the patient stated that she no longer felt fetal movements and fetal heart sounds could not be detected. Four days later, roentgenography demonstrated overlapping fetal skull bones. A sterile vaginal examination disclosed a palpable mass, thought to be the uterus separate from the fetus. Surgery was delayed until hystero-radiography demonstrated the outline of the uterine cavity with dye passing through a tear into the abdominal cavity. Films demonstrating this were made at intervals after the injection of 2.5 c.c., 5 c.c., 7.5 c.c., and 10 c.c., respectively. These are reproduced in the article.

Laparotomy confirmed the diagnosis. A tear was found through the old operative scar in the uterus. The fetus, amniotic sac, and placenta were lying free in the abdominal cavity. Following hysterectomy, the postoperative course was uneventful.

The author feels that such "quiet" cases of ruptured uteri may be more common than realized, and that in many cases death from this cause may have been attributed to "childbirth, postpartum hemorrhage, etc." Hysterosalpingography will aid in clarifying the diagnosis when it would otherwise remain obscure.

STANLEY H. MACHT, M.D.

X-ray Studies in Hysterosalpingography, Using a New Cannula. A. P. Hudgins. *Am. J. Obst. & Gynec.* 49: 31-435, March 1945.

Hudgins describes his variation of the Colvin screw-type cannula for obturation of the uterine cervix during hysterosalpingography. The modification includes the use of a ball valve and a removable handle so that the cannula, once properly inserted, can be left in place, the handle removed, and the patient allowed up and about with the oil retained by the valve. The cannula is inserted in the cervix under sterile precautions, and about 6 c.c. of iodized oil is injected. The patient is then allowed to walk about for thirty minutes and a radiograph is made at the end of that time. Apparently this is all done without anesthesia or, at the most, with local anesthesia and mild sedation. No mention is made of fluoroscopy. Only one film is taken at the thirty-minute interval and this, according to the author, usually serves the purpose of two or more films necessary by ordinary methods. The theory is that the muscular contractions of the uterus, under the stimulus of distention, will force the oil out through the tubes and into the pelvis. In the thirty-minute period, sufficient contraction is said to occur in most instances to produce this result.

The single film obtained should show filling of the uterine cavity and some oil about the fimbriated ends of the uterine tubes and in the pelvis if the tubes are patent. The author feels that this is a more accurate test than would be obtained by the ordinary method.

In those cases in which the film shows obstruction of the ovarian tubes, he has found that it may be advisable to leave the cannula in place for twelve to twenty-four hours. The rhythmic muscular contractions are kept up during this entire period and there is, he believes, more chance for opening up closed tubes than by repeated injections of oil with pressure maintained at a relatively high level for only a short period of time. No statistics as to the success of the method are given.

There are some apparent advantages in the use of this method of hysterosalpingography, though the abstractor believes that fluoroscopic guidance in the injection of the oil and study of the uterine contractions of considerable help in making the examination more complete.

BERNARD S. KALAYJIAN, M.D.

THE GENITO-URINARY SYSTEM

Preventive Treatment of Calcium Urolithiasis: Important Role of Early and Frequent Roentgenographic Examinations. R. H. Flocks. *J. Urol.* 53: 427-439, March 1945.

Certain conditions are known to predispose to stone formation. This is true where immobilization of the individual takes place, where portions of the urinary tract are paralyzed, and where obstruction and infection of the urinary tract occur as a result of trauma. Though the mechanism of the occurrence of stone in these situations is quite well understood, in spite of meticulous

preventive measures, stones may occur. The three fundamental factors are hypercalcinuria, urinary stasis, and urinary infection. Under the conditions of recumbency, hypercalcinuria cannot be prevented. It may be counteracted by maintaining a large urinary output, i.e., dilution of the urine. The preventive treatment of calcium urolithiasis in immobilized patients consists of: (1) maintenance of a large fluid output; (2) control of diet; (3) control of stasis; (4) control of infection; (5) continuation of treatment for three months after immobilization has ceased; (6) frequent roentgenographic check-up examinations. It is the last of these measures that the author emphasizes here.

Prompt diagnosis is important because in their early stages calcium stones are loose masses of small concretions which can in many cases be broken up and washed out, or caused to pass before any extensive damage has occurred and without the need of an open surgical procedure. Several cases are presented to illustrate the importance of thorough and frequent roentgenographic examinations during and after the occurrence of conditions predisposing to calcium urolithiasis.

The method of examination used calls for a plain roentgenogram and another twenty minutes after the intravenous injection of 20 c.c. of diodrast. "This is done one month after the onset of the predisposing condition and then one month, two months, three months, and every six months for one year after the onset of the predisposing condition." If stones or other complications such as urinary infection occur, the examinations are made more frequently.

CHARLES R. PERRYMAN, M.D.

Renal Cyst, Solitary. John W. Martin. *J. Kansas M. Soc.* 46: 73-75, March 1945.

The case of solitary renal cyst reported here came to light in the course of an examination occasioned by an industrial accident that was considered to have caused a back injury. In routine x-ray examination of the lumbar spine, a bizarre shadow was observed in the region of the left kidney. Retrograde pyelography showed the left kidney pelvis partially obscured and displaced anteromesially by a large soft-tissue mass containing streaks of calcification, occupying the lower pole of the kidney. The diagnosis of solitary renal cyst was confirmed at operation and subsequent pathologic examination. Questioning of the patient revealed a history of recurrent colds and frequent and urgent desire to urinate, usually in the mornings, for the past eight years. He had also suffered from severe left-sided backache, occasionally requiring bed rest for four or five days, during the past two years.

LESTER M. J. FREEDMAN, M.D.

An Unusual Horseshoe Kidney: Case Report. Henry Bodner and Max K. Moulder. *Urol. & Cutan. Rev.* 49: 160-161, March 1945.

A case of horseshoe kidney with three distinctly separated pelves is reported. Retrograde pyelograms revealed a rotated right kidney and a slightly dilated right renal pelvis. On the left, the ureter showed a bifurcation at the level of the fifth lumbar vertebra: one slightly dilated renal pelvis lay in the left paravertebral region, while a second renal pelvis occupied an oblique position across the fourth and fifth lumbar vertebrae. Intravenous pyelography failed to reveal any evidence of the third renal pelvis bridging the lower pole of the two kidneys; apparently, no function was present.

However, moderate pathological changes had occurred in the middle calices and pelvis, as shown in the retrograde pyclograms. MAURICE D. SACHS, M.D.

THE SPINAL CORD

Intraspinal Lipomas. Report of Cases, Review of the Literature, and Clinical and Pathologic Study. George Ehni and J. Grafton Love. *Arch. Neurol. & Psychiat.* 53: 1-28, January 1945.

Intraspinal lipomas without associated spina bifida are rare, comprising only about 1 per cent of all intraspinal tumors. Approximately three-fifths of the lipomas are intradural and two-fifths are extradural.

In a lengthy but well written article, Ehni and Love present the many interesting features of these lesions. Illustrative case reports and separate tabulations of previously reported intradural and extradural lipomas

supplement descriptions of the clinical, laboratory, anatomic, pathologic, and etiologic aspects of these tumors.

The roentgenologic signs of intraspinal lipoma are characteristic. One may encounter widening of the neural canal due to thinning of the pedicles and erosion of the backs of the vertebrae, but such abnormality is common in the case of other intraspinal tumors. When the involvement is in the cervicothoracic region it extends over three, four, five or more vertebrae, the possibility of intradural lipoma should be considered. This is particularly true if the changes have been present for several years. It is emphasized, however, that neither age at onset nor duration of symptoms seems to bear any relation to the presence of osseous changes. Myelography is sometimes helpful in demonstrating a partial or complete block in the spinal canal.

JOHN F. HOLT, M.D.
(University of Michigan)

RADIOTHERAPY

Problems of Cancer Biology. R. R. Spencer. *J. A. M. A.* 127: 509-514, March 3, 1945.

For years, as chief of the National Cancer Institute, Dr. Spencer has been in close touch with the far-flung activities of the nation's foremost students of neoplasia. From his unique vantage point he has gathered together what may well be considered to be the highlights of the sum of current knowledge bearing on this subject. Giving due credit to advances which have been made in the discovery and the study of carcinogenic agents, he points out that no method has yet been offered for halting or reversing the carcinogenic process once it has begun.

The activities of major cancer research agencies in the United States are listed and the steps are suggested which are calculated to bring nearer a practicable defense against human cancer.

FRED JENNER HODGES, M.D.
(University of Michigan)

Discussion on Post-War Organization for the Treatment of Cancer. E. Rock Carling, George F. Stebbing, John R. Nuttall *et al.* *Proc. Roy. Soc. Med.* 38: 147-154, February 1945.

Sir E. Rock Carling states that a number of the schemes sent up for approval of the Ministry of Health under the British Cancer Act are unsatisfactory in that they do not provide for both surgical specialists and radiotherapists working in conjunction. He believes that the organization should be concentrated in a few fully equipped and strongly staffed institutions with a very small group of subcenters. For hospitalization purposes the country outside of London could be divided into about 12 major regions with a university center as its headquarters. Within the "region" would be several subcenters, "districts." At the periphery there should be preliminary investigation centers accessible to patients' homes. Health centers and cottage hospitals could serve this purpose. The headquarters team of specialists should be available for consultation at all levels within the region.

A single radiotherapeutic organization can deal with a population of four million, with a million as a minimum and about two million optimum. The radiotherapist should be consulted in every case. Applications of radium or radon should be done by the specialist within

the group best able to apply it in a manner to obtain uniform dosage to the area treated.

Research should play an important part at all levels in the organization. Organized training for all types of technical assistants is a necessity.

The formulation of any cancer scheme should be dictated solely by the interest of the patient. The patient should be educated to be satisfied with nothing less than the best available.

Stebbing mentions causes for the unnecessarily high cancer death rate in the United Kingdom. There has been a rapid increase in knowledge and marked development of equipment needed for the early diagnosis of cancer but neither is possessed by a sufficient proportion of practitioners. Under the National Health Service scheme many doctors have to see so many patients that they cannot find time for careful consideration of obscure symptoms. Manifestations of cancer are so diversified that only a team of specialists can deal with the various forms most effectively. Many hospitals have neither an efficient radiotherapy department nor arrangements for obtaining radiotherapy elsewhere.

All services rendered will be part of those provided under the National Service scheme. The facilities of the organization should be available to private patients under suitable financial arrangements. Both "public authority" and voluntary hospitals must take part in the program and some difficulties are expected in obtaining full co-operation.

Stebbing stresses the importance of keeping adequate records and believes that they should be separate from and in addition to, the regular hospital records.

Nuttall emphasizes the need for radiotherapists to have a good knowledge of surgery and for the surgeon to know the possibilities of radiotherapy in order to choose the mode of treatment or combination of methods most effective in each case may be used. He believes that radical mastectomy is done too often in "inoperable" cases of breast carcinoma. Block dissection of cervical lymph nodes is a valuable procedure, not done with enough frequency, and too few surgeons are expert at it. Radium and x-ray treatment should be organized as a unit—radiotherapy. All histologic slides should eventually pass through a central pathology unit to provide a wider fund of experience to the pathologist and uniformity of opinion for the clinician.

The advisability of notification in all cancer cases was discussed by others. It was advocated on the grounds that the cases once diagnosed could be followed accurately. Chief objection to it was that it might discourage some patients from presenting themselves early for diagnosis and treatment. Notification by serial number was suggested. H. H. WRIGHT, M.D.

Cancer Treatment with Radium Bearing Moulds. Kurt Wiener. Wisconsin M. J. 44: 297-300, March 1945.

Radium-bearing moulds are mainly used in the treatment of cancers of the oral cavity and the lips; less often, of the face and external genitalia. In certain positions at these sites, this is one of the best methods of irradiation. It should not, however, be depended on to the exclusion of other varieties of radiation therapy, and should, when indicated, be followed by deep x-ray therapy to the regional lymphatics. The author describes the construction of the moulds and gives some suggestions as to dosage. ELLWOOD W. GODFREY, M.D.

Individualization in the Management of Carcinoma of the Maxillary Sinus. Maurice F. Snitman. Ann. Otol., Rhin. & Laryng. 54: 125-135, March 1945.

The plan of management for carcinoma of the maxillary sinus described here consists in the application of radium within the cavity as a supplementary measure to external protracted irradiation, after exposure of the antrum by conservative surgical intervention.

The location of the bone destruction permits a general division of the sinuses into two chief "malignancy areas," as suggested by Ohngren (Acta oto-laryng., supp. 19, 1933). A line, extending from the inner angle of the eye to the angle of the jaw, divides the antrum into a suprastructure and an infrastructure. Lesions above the line, situated medially, are frequently associated with nasal polyps, encroach on the meninges more readily, and tend to early lymphatic invasion. In the lateral part of the suprastructure, carcinoma has at its onset the most dormant development. It then rapidly invades the malar bone, producing the characteristic tumefaction of the external angle of the floor of the orbit. Carcinoma in the infrastructure of the antrum produces earlier symptoms, referred to the teeth.

Two chief factors enter into the consideration of a therapeutic regime: the site of the primary lesion and the presence or absence of lymphatic extension. The element of radiosensitivity of antral carcinoma can be gauged only by the responses of the cancer in general, since protracted fractionated irradiation has as yet not received sufficient trial. Lesions involving the roof of the sinus present a most unfavorable prognosis, and it is unfortunate that this area is the affected site in most cases. Adequate surgical treatment here would require a mutilating procedure with sacrifice of the eye in many cases. Good results have been reported with electro-surgery and radium implantation but there is still much to be desired. Lesions in the floor of the sinus with involvement of the hard palate and alveolar ridge are amenable to intra-oral surgical removal, followed by local radium application.

Treatment of the primary lesion is not affected by the presence of regional metastases. The management of the involved nodes follows closely the plan employed at the Memorial Hospital, New York. In brief, no prophylactic dissection or irradiation is performed. If the involved nodes are operable and the

control of the primary lesion is assured, neck dissection is performed, providing certain requirements are met (Duffy: Am. J. Roentgenol. 39: 767, 1938. Abst. in Radiology 32: 370, 1939). If the nodes are inoperable, the patient is submitted to external irradiation supplemented by radon seed implantation.

Two proved cases of maxillary sinus carcinoma are presented, which illustrate in detail the specific radium and x-ray factors involved.

STEPHEN N. TAGER, M.D.

Necrotizing Bronchopneumonia: Its Relation to Radiation Therapy of Cancer of the Oral Cavity. Lauren V. Ackerman, H. M. Wiley, and David V. LcMone. Am. J. Roentgenol. 53: 281-289, March 1945.

Patients with cancer of the oral cavity have an excellent chance of acquiring necrotizing bronchopneumonia (aspiration pneumonia), particularly if the lesion interferes with deglutition. Oral sepsis, malnutrition, and poorly planned radiotherapy are all contributing factors. If a patient with cancer of the oral cavity begins to lose weight rather quickly and shows a rapid pulse with a low-grade fever, necrotizing pneumonia should be considered. There is often coughing, but little or no dyspnea or sputum. The breath is not foul, as in lung abscess, nor is clubbing of the nails present. Roentgenologically there are always changes in the lower lobes; occasionally there may be involvement in the upper lobes as well. The lesions are lobular in character and of bronchial distribution. The areas of involvement will at first have a patchy to confluent cloudiness but, as the disease progresses and liquefaction of the center occurs, areas of rarefaction will make their appearance and the diagnosis will be more obvious.

Scrupulous mouth hygiene and the extraction of all teeth are indicated before starting roentgen therapy of cancer of the oral cavity. The fields should be as small as possible, with adequate filtration and protraction of irradiation over a rather long period. In treatment of the pneumonia, roentgen therapy is probably the only specific agent which may be of value. A fairly large field should be selected and small doses given for three or four days.

The authors saw 14 cases of necrotizing pneumonia, in only 2 of which recovery took place. Twelve patients died after completion of treatment for a malignant neoplasm of the oral cavity, the shortest time interval before death being three days and the longest period eleven months.

CLARENCE E. WEAVER

Irradiation in Carcinoma of the Breast. Roy G. Giles. Texas State J. Med. 40: 585-589, March 1945.

This report is based on a study of 191 unselected cases of mammary gland carcinoma. In accordance with the clinico-pathological classification suggested by Portmann (Cleveland Clin. Quart. 10: 41, 1943), 63 cases, or 33 per cent, were placed in the inoperable Groups 3 and 4. Sixty per cent of the 122 cases from which biopsy material was obtained showed involvement of the axillary lymph nodes. Theoretically, clearly operable cases of breast cancer are those in which the malignant tissue has not extended beyond the area that can be excised. Since distant metastases may be present despite the appearance of a seemingly operable case, routine x-ray examination of the spine, pelvis, and chest is urged.

Prognosis depends upon the histologic grade of malignancy as well as on the anatomic extent of the growth.

The five-year clinical cure rate is about three times as high in those with the disease limited to the breast as in those with extension to the axilla.

Forty-eight cases in the present series showed pulmonary metastases. The tracheobronchial lymph nodes were involved in 5 cases. Parenchymal lesions were of four types: nodular in 12 cases, infiltrative in 5 cases, miliary in 2 cases; and massive, with consolidation of an entire lobe or segment thereof. There were 9 cases of pleural thickening and effusion, which are difficult to differentiate from the massive parenchymal type. Palliative roentgen therapy for pulmonary metastases often results in marked relief. One case has been under observation by the author for seven years.

Skeletal metastases were discovered in 12 of the 191 cases (25 per cent of the 63 inoperable cases). Pain was present in many instances before the lesions could be demonstrated roentgenologically. The author states that palliation may be expected in 70 per cent of the cases after application of protracted small doses of x-ray to the affected bones.

The status of roentgen castration in breast carcinoma is reviewed and the impression is gained that this procedure is of definite value especially in the presence of metastatic bone lesions. The author cites one case of his own, previously reported (*Am. J. Roentgenol.* 14: 442, 1925), in which bone metastases showed a favorable response to pelvic irradiation following radical mastectomy.

LESTER M. J. FREEDMAN, M.D.

Principles of Treatment of Carcinoma Cervix Uteri by Radiotherapy. Bernard Sandler. *Proc. Roy. Soc. Med.* 38: 175-183, February 1945.

Sandler holds that x-ray and gamma ray treatment has hitherto rested largely on an empirical basis. In order to deliver a lethal dose to the cancer cells in the primary tumor and in potential sites of invasion the radiotherapist needs to know how the radiation acts, what a lethal dose is, and where and how such a dose shall be delivered.

Choice of wave length, dosage rate, spacing of treatments, and total dosage depend on an understanding of the behavior of both normal and malignant cells exposed to radiation. Radiation can induce either a temporary or permanent effect. There is experimental evidence that a relatively small dose (5 to 600 r) may bring about death of the cell by damage to the nucleus. The daughter cell, being deficient in nuclear content, will die. With the death of several adjacent cells, break-up of the tumor parenchyma occurs and the indirect effect of the radiation comes into play. If cells are killed too rapidly and in too great a number, the repair process will be unable to function properly and fibrosis may occur prematurely. Cytological analysis of the radiation effects at the stage while the intra- and intercellular processes are in progress is urged to control the treatment.

In a series of cases of squamous carcinoma of the cervix the author delivered 100 r by x-ray and twenty-four hours later took a biopsy specimen from the cervix. Although the tumors were histologically similar, great variation was observed in the response. In one case only 5 per cent and in another 45 per cent of the dividing chromosomes showed abnormalities. By such cytologic control, much more intelligent determination of dosage may be possible.

Cytological research is urged to determine the effectiveness in timing and spacing of single and cumulative

radium insertions. Information may also be gained to the best combinations of roentgen and gamma rays from a biological point of view.

The problem of determining the size, extent, and position in relation to the pelvis of the primary tumor and the possible paths of invasion is complicated by the fact that only a portion of the tumor is usually accessible to vaginal measurement. The volume of tumor treated includes not less than the true pelvis and, in many cases, more, since the iliac nodes have been demonstrated at times to lie above the brim of the pelvis. The function of x-ray therapy is to reach those areas not adequately treated by radium. The author objects to the usual employment of symmetrical x-ray fields about the mid-line, because the radium lethal isodose level may be symmetrical but not about the mid-line or may not be symmetrical in any plane. In the methods used, the most penetrating portion of the beam is not directed at the pelvic wall, where the tumor is greatest.

The importance of obtaining proper spatial distribution of dosage is stressed. Mayneord has described methods of ascertaining the three-dimensional distribution from radium sources and of expressing results in isodose charts or as models. With this knowledge of accurate determination of the position of the application in relation to the pelvis, x-ray therapy can be delivered to the portions of the pelvis where it is most needed. Complete co-operation between the gynecologist and radiotherapist is essential.

H. H. WRIGHT, M.D.

Effect of Deep X-Rays on the Peritoneal Metastases of an Ovarian Carcinoma. James Watt. *Proc. Roy. Soc. Med.* 38: 175-183, February 1945.

Watt reports the case of a married woman, aged 54, who presented a history of colicky lower abdominal pain of three weeks' duration, and on examination showed a firm mass arising from the pelvis and reaching almost to the umbilicus. At laparotomy the peritoneal cavity contained some free fluid; secondary growths were present on the walls of the cavity and the omentum; the pelvis contained a mass arising from the left ovary and spreading directly onto the pelvic colon. Biopsy of a nodule from the omentum showed spindle-cell carcinoma. A course of deep x-ray therapy was given covering the whole peritoneal cavity (dosage and physical factors not mentioned). Six months later the patient appeared in good health, was gaining weight, and no abdominal mass could be detected. Eleven months following laparotomy, a cystic swelling was found, arising from the pelvis. Exploration at this time showed no secondary deposits in the peritoneal cavity. The right ovary appeared normal and was left in place. The left ovary and its cystic mass were removed. Its walls contained nodules which on section showed papilliferous carcinoma with large areas of necrosis.

The author suggests that following x-ray therapy in such cases, if there is evidence of marked regression, the abdomen should be opened to determine whether the primary growth can be removed.

H. H. WRIGHT, M.D.

Relationship of Epithelial Buds to Carcinoma of the Pelvis of the Kidney, Ureter and Bladder. Albert E. Bothe. *J. Urol.* 53: 451-458, March 1945.

The author briefly reviews the literature concerning the occurrence of epithelial buds and nests within the

urinary tract. He has himself shown epithelial cell nests to be present in 38 of 54 consecutive autopsy cases. In no case in this series was there any neoplastic change associated with urinary tract buds or cell nests, even though malignant tumors of various types were found in 14 of the 38 cases.

Twelve surgical specimens were also studied, all showing carcinoma of some portion of the urinary tract. Examination of tissues adjacent to and distant from the primary carcinoma, which did not appear malignant, showed subcutaneous hyperemia with associated round-cell infiltration, sometimes with digitation of epithelial cells into the subepithelial supporting tissue. Other cases in the subcutaneous tissue showed islands of epithelial cells, identical with the buds found in the necropsy material. This was so in all the surgical specimens.

The author mentions the possibility that these immature buds may be the tissue susceptible to activation on a systemic chemical basis and states that x-radiation may render these buds inactive. He cites two of our patients all with multiple small papillomas of the bladder who were treated by x-ray followed by transurethral desiccation. The other two patients were treated by desiccation alone. The first two patients have never had a recurrence, while the latter two have had repeated recurrences. Photomicrographs and drawings are included.

N. P. SALNER, M.D.

Carcinoma of the Prostate. Harold J. Ham. M. J. Australia 1: 168-169, Feb. 17, 1945.

Ham admits that results from radiotherapy in carcinoma of the prostate have been discouraging, particularly when one is considering cure or length of survival after treatment. He considers it a valuable adjunct in treatment, however, both in the control of the primary growth and relief of pain.

Between 1933 and 1941, inclusive, 49 patients were treated in the x-ray department, Sydney Hospital (Australia). These received various combinations of surgery, x-ray, and radium. The group receiving endoscopic resection combined with deep x-ray therapy gave the best results.

The author believes that improved technique, with multiple small fields carefully localized to the prostatic region and use of higher voltages, may offer considerably better results in control of the primary tumor.

The principal value of x-ray therapy in bone metastases is in relief of pain, definite palliation being reported in more than two-thirds of the cases treated. Lymph-node metastases may sometimes prove radiosensitive.

Mention is made of reports of several writers on the effect of irradiation of the testis. In view of Munger's encouraging report, the author suggests further trial of irradiation of the testes, using larger doses.

H. H. WRIGHT, M.D.

EFFECTS OF RADIATION

Myelomalacia of the Cervical Portion of the Spinal Cord, Probably the Result of Roentgen Therapy. Lewis D. Stevenson and Robert E. Eekhardt. Arch. Path. 39: 109-112, February 1945.

A man with lymphoepithelioma of the nasopharynx was given roentgen therapy (200 kv., 50 ma.) through five portals from October 1941 to January 1942, as follows:

Intraoral

2.5 cm. around
40 cm. target-skin distance
0.5 Cu + 1 Al filter
Total dosage 4,000 r (10 treatments)

Right temporal

6 cm. around
50 cm. target-skin distance
1 Cu + 1 Al
Total dosage 4,000 r (16 treatments)

Left temporal: Same as right

Right cervical

13 × 6 cm.
50 cm. target-skin distance
1 Cu + 1 Al
Total dosage 4,000 r (16 treatments)

Left cervical

12 × 9 cm.
50 cm. target skin distance
1 Cu + 1 Al
Total dosage 5,750 r (23 treatments)

The lesions disappeared completely following this treatment. In November 1942 a necrotic area developed in the mid-line on the posterior part of the hard palate; this responded to local irrigations. In September 1943, a 2-cm. node was found in the soft

tissues over the insertion of the right sternocleidomastoid muscle. To this node were given 4,500 r (15 × 300 r) with 200 kv., 15 ma., 50 cm. target-skin distance, 0.5 Cu and 1 mm. Al filtration. The node disappeared, and an ulcer over the site healed promptly. In November the patient began to notice stiffness and clumsiness of the left arm and the left leg. He complained of constipation and on three occasions urinated involuntarily. He also became impotent. Physical examination disclosed nothing remarkable except for induration of the tissues of the neck in the region of the previous irradiation. Roentgenography of the chest revealed only apical pleural thickening and mild emphysema. Neurologic examination showed hyperreflexia of the left side, left finger stretch, absence of abdominal reflexes on the left, and a Babinski sign on that side. There was motor weakness of the left side, not including the face. Re-examination three days later showed that a finger stretch and a Babinski sign had appeared on the right side, that sensation to pinprick was lost below the third thoracic segment bilaterally. The sensation of heat was lost below the fourth cervical segment bilaterally, but sensation of touch was normal throughout.

It was thought that there was a rapidly expanding intramedullary lesion in the region of the fourth cervical segment, possibly a metastasis, and a cervical laminectomy was performed. The cord and the dura from the sixth cervical vertebra to the foramen magnum appeared normal, with no evidence of epidural or intramedullary growth and no apparent vascular changes. Following operation, the patient's symptoms progressed to include both sides, and complete urinary incontinence developed. Since it was thought that the laminectomy had ruled out late radiation fibrosis and adhesive arachnoiditis of the cord, a course of

roentgen therapy was directed to the cervical cord for the possible effect on any undisclosed metastasis. Through an 8-cm. portal in the posterior cervical region 3,300 r (11×300 r), with 200 kv., 15 ma. at a 50 cm. target-skin distance and with a filter of 0.5 mm. Cu and 1 mm. Al, was given. Despite this, the patient's condition became progressively worse and he died in February 1944, apparently of respiratory paralysis. Autopsy revealed myelomalacia of the cervical part of the cord, in the vicinity of which many thickened arterioles with fibrous walls could be seen. The vertebral marrow was infiltrated in large areas by epithelial cells with collections of lymphocytes, in conformity with the diagnosis of lymphoepithelioma.

This case shows an unusual end-result of radiation therapy. It is calculated that this patient received 6,000 to 8,000 r at the level of the spinal cord. The possibility of such a reaction should be kept in mind when roentgen therapy is directed to the neck.

The Effects of Roentgen Radiation on the Thymonucleic Acid Content of Transplantable Mammary Carcinomas. Robert E. Stowell. *Cancer Research* 5: 169-178, March 1945.

The relative thymonucleic acid content of transplantable mammary carcinomas in rats and mice was measured by means of the Feulgen reaction and a special microphotometric apparatus. The tumors on one side of the animal were irradiated while those on the other side were protected by lead shielding and used as controls. The dosage, which varied up to 4,000 r, was insufficient to produce definite regression of the tumors, but growth retardation was evident in many instances.

The 6 rat tumors receiving 4,000 r showed a mean decrease of 13 per cent and of 5 per cent in their content of thymonucleic acid per area and per cell, respectively. The effects of 2,000 r on 6 rat tumors were more variable and less significant. The 16 irradiated mouse tumors showed a mean decrease in thymonucleic acid content per area and per cell of 5 and 3 per cent, respectively. In 9 of the 16 the decrease in thymonucleic acid per area was statistically significant, and in 4 of these the decrease per cell was significant.

The results of these experiments would support a hypothesis that roentgen radiation may alter the molecular structure of vital substances within the nucleus and produce a disturbance of the nucleoproteins, which in some instances is followed by death of the cell. Mitchell (Brit. J. Exper. Path. 23: 285, 1942) found that ribonucleic acids are increased in the cytoplasm following irradiation. The present observations, which show a decrease in desoxyribonucleic acid in irradiated cells, suggest that one of the most important intracellular effects of roentgen radiation is the production of an upset

in the normal balance and metabolism of both types of nucleic acids.

Effect of Colchicine and X-Rays on Onion Root Tips. Michael Levine. *Cancer Research* 5: 107-119, February 1945.

The author presents a comprehensive review of the literature dealing with the effect of colchicine ($C_{42}H_{32}NO_6$) on plant and animal tissues. When applied in small doses, it has been shown to produce a retarding effect on mitosis in the cells of either growing vegetative or germinal tissue. In tumors, the mitotic phase stage of the active peripheral cells is prolonged so that the number of cells in division—and therefore vulnerable to the effect of radiation—is increased. Studies of the combined effect of colchicine and x-rays on tumor growth have, however, been inconclusive. In view of this the author conceived the idea of treating with colchicine and x-rays a "simple fundamental tissue meristematic in nature and responsive to both agents in the hope that such a study would serve as a forerunner of a similar investigation with animal tumors of cytogenic homogeneity. As his simple fundamental tissue he chose root tips of the common onion (*Allium cepa*). The bulbs were kept in a solution of 0.01 per cent colchicine in tap water and after certain intervals were exposed to doses of 900, 1,500, or 3,000 r (200 kv., 25 ma., 0.5 mm. Al, 42 to 67 cm. distance, 95 to 133 r per minute). Untreated bulbs and those treated only with colchicine or only with x-rays served as controls.

The effect of exposure to colchicine for more than 48 hours, coupled with 900 r, prevented growth of the root tip; 48 hours' exposure to colchicine with 1,500 r induced similar results. With the shorter exposures to colchicine (18, 24, 36 hours) and 1,500 r, the hyperplastic tips produced only a limited growth, which came arrested five to seven days after their return to water. Exposures of 48 hours combined with 3,000 r prevented further growth.

Irradiation with 900 r, 1,500 r, and 3,000 r impeded growth; the time for recovery was proportionately less than that required for the combined effects of colchicine and x-rays.

The leaves of bulbs colchicized and irradiated with 1,500 r or 3,000 r were retarded in subsequent growth compared with those treated by x-rays only. Bulbs colchicized only showed leaf growth approximately equal to the untreated plants. The combination of (a) an exposure of 900 r and treatment with colchicine for less than 72 hours and (b) 1,500 r and 48 hours of colchicine are most effective in arresting growth of fundamental plant tissues such as the root tip of the onion.

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The Roentgen Anatomy of the Skull in the Newborn Infant¹

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IN ORDER TO learn more of the normal and of normal variations, the skulls of 100 infants were examined roentgenologically. Many of the landmarks so familiar in the adult do not appear in the infant, and similarly the common appearance of the infant's skull is no longer present in the older person. By a comparison of the infant's roentgenograms with the actual skull of the newborn, many of the structures observed on films can be identified. The major purpose of this paper is to indicate these points of interest.

Embryology of the Skull (1, 3, 4). The difference in appearance of the infant's skull from that of the adult can be appreciated better by a brief review of the embryological development. The earliest evidence of the cranium is found in dense masses of mesenchyme which embrace the cranial end of the notochord as the parachordal plates and extend into the primitive ethmoid region as the trabeculae cranii. Dense mesenchyme also encloses the auditory, nasal, and optic centers. In the basisphenoid and basioccipital and around the auditory vesicles there is found the first evidence of the intracartilaginous skull. The developing mesoderm grows from these areas around the brain until the latter is enveloped by the membranous

cranium. The primitive cranial foramina are left when the developing cranial membrane grows around the cerebral nerves.

Approximately at the beginning of the second month, fusion of the mesenchymatous elements takes place, followed by cartilage formation, resulting in the formation of the primitive base of the cranium. Cartilage also forms around the auditory and olfactory primary centers. In the beginning this cartilage is widely separated from that of the base of the cranium. By the time the fetus is approximately forty-five days old, however, the auditory capsule has fused with the basal cartilage. A broad, thin cartilaginous plate grows from the lateral region of the occipital cartilage around the lower portion of the brain to form the early foramen magnum.

The entire fused cartilaginous area is known as the chondrocranium. In it various centers of ossification begin to appear, and it is converted almost entirely into bone. The chondrocranium, however, is continuous with the cranial vault, and consequently some of the skull bones are of both cartilaginous and intramembranous origin. On the other hand, the bones of the cranial vault, the vomer, and the bones of the face are entirely of intramembranous

¹ From the Department of Radiology of the Elizabeth Steel Magee Hospital, Pittsburgh, Penna. Presented at the Joint Meeting of the American Roentgen Ray Society and the Radiological Society of North America, Chicago, Ill., Sept. 24-29, 1944.

TABLE I: EMBRYOLOGY OF THE SKULL (1, 3, 4)

Skull Bones	Number in Skull	Number of Ossification Centers for Each Bone	Remarks
BONES OF PURELY MEMBRANOUS ORIGIN			
Parietal	2	1	} 1 center on either side of mid-sagittal plane
Frontal	1	2	
Nasal	2	1	} Centers of ossification arise in mesenchyme of facial region
Lacrimal	2	1	
Zygomatic	2	1	
Vomer	1	2	Centers arise in connective tissue on either side of inferior end of lamina perpendicularis of ethmoid
Maxilla	2	2	The first branchial arch bifurcates to form
Palate	2	1	
			(a) the superior maxillary process (in which the palate and maxillary bones develop in membrane) and
			(b) the inferior mandibular process (the mandible of intramembranous origin developing herein as paired centers of ossification lateral to the body of Meckel's cartilage, this cartilage forming the axis of the mandibular process of the first branchial arch)
COMPOUND BONES (FORMED CHIEFLY IN CARTILAGE BUT PARTLY IN MEMBRANE)			
Occipital	1	9	(a) Cartilaginous origin (1) Basilar part (1 center) (2) Lateral parts (1 center for each) (3) Supra-occipital part (the squama below the superior nuchal line) (4 centers, 2 on either side of mid-line) (b) Intramembranous origin (1) Interparietal part (the squama above the superior nuchal line) (2 centers, 1 on either side of mid-line)
Sphenoid	1	18	(a) Cartilaginous origin (1) Body (2 centers in presphenoid portion, 2 in basisphenoid portion, and 1 in each lingula) (2) Greater wing (1 center in each) (3) Lesser wing (1 center in each) (b) Intramembranous origin (1) Orbital and temporal margins of greater wing and medial portion of each pterygoid process (except the hamular process) (4 centers on each side)
Temporal	2	5	(a) Cartilaginous origin (1) Petrous. A complete bony capsule results from fusion of several centers of ossification which fuse early, the capsule enveloping the inner and middle ear. Mastoid process formed postnatally from petrous (2) Tympanic. Formed by ossification of cartilage around inner end of external auditory meatus (3) Tympanohyal and (4) Stylohyal. These develop from cartilage formed from visceral arches. They unite to form the styloid process (b) Intramembranous origin (1) Squamous. Arises from lateral wall of primitive cranium

Table cont. on opposite page

origin, and ossification occurs directly in the membrane.

In an attempt to show more clearly the

manner in which the skull develops, it seems advisable to present some of the facts in tabular form (Table I).

TABLE I: EMBRYOLOGY OF THE SKULL—*cont.*

Skull Bones	Number in Skull	Number of Ossification Centers for Each Bone	Remarks
BONE OF CARTILAGINOUS ORIGIN Ethmoid	1	5	(a) Mesial mass of cartilage extending from tip of nasal process to sphenoid. Terminal part persists as cartilaginous nasal septum. Ossification of upper portion forms perpendicular plate and crista galli (b) A pair of cartilaginous masses lateral to the olfactory sacs ossify into spongy bone of ethmoidal labyrinths. Resorption of this bone and invagination of nasal mucous membrane produce nasal turbinates and ethmoidal cells (c) Cartilaginous trabeculae surrounding olfactory nerve fibers lateral to mesial mass of cartilage connect the mesial and lateral masses. These trabeculae ossify, forming the cribriform plates

The Skull at Birth: Schüller (7) quotes Tueller to the effect that under certain conditions a change in the skull shape is wrought about in intrauterine life through the pressure of the uterine wall resulting from scanty amniotic fluid, and through the long-continued resting of the head upon the pelvic inlet. Labor produces a further remodeling of the head. Schüller also states that for every fetal position there is a characteristic molding of the skull. He writes that the skull born with an occipital or face presentation is a long skull; that born with frontal presentation a high skull; that born with vertex presentation a short skull. This author believes that these varieties of skull shapes have existed in less pronounced degree before birth, and that they decisively influence the position of the head in its passage through the pelvis.

Moloy (5) discusses the changes which take place in the fetal skull during labor as a result of molding, with particular stress on changes in the base of the skull. He believes that in the process of molding there is locking of the frontal and parietal bones at the coronal suture and, to a less marked degree, of the occipital and parietal bones at the lambdoid suture. Compensating changes at the base, consisting of elevation of the occipital region with bending at the sphenopetrous angle, take place. As a result, bending and displacement

are permitted by the above method of locking. Moloy says further that at birth, both in the molded head and in the head delivered by cesarean section, the coronal and lambdoid suture lines are either closed or show very slight separation. A separation at these suture lines begins shortly after birth and increases rapidly in the postnatal period.

The greatest length of the skull is defined by Schüller (7) as the distance from the most remote point of the occiput to the forehead, the greatest breadth as the distance between the opposite points of the temporal region most distant from one another, and the greatest height as the distance from the anterior edge of the foramen magnum to the highest point of the vertex. Neumayer, quoted by Schüller, found that at birth the post-auricular part of the cranium is larger than the pre-auricular portion.

A comprehensive description of the general roentgen appearance of the skull in the newborn is given by Pancoast, Pendergrass, and Schaeffer (6). They note the disproportionately large size of the skull at birth in comparison with the body, and the predominance of the cranial over the facial portion, with a ratio of eight to one. In discussing the development of the skull, these authors comment on the absence of mastoid processes as such at birth, while the maxillary and

TABLE II: EXPOSURE FACTORS IN EXAMINATION OF THE NEWBORN SKULL

Views Made	Average Measurement in Centimeters	Kv.P.	Ma.	Time in Seconds	Target-Film Distance in Inches	Screens	Exposure
P.A. (Nose-Forehead)	12	63	480	1/2	36	Par speed	Yes
P.A. (Waters)	13	69	480	1/2	36	Par speed	Yes
Occipital	13	69	480	1/2	36	Par speed	Yes
Base	13	71	480	1/2	36	Par speed	Yes
Lateral	10	58	480	1/2	36	Par speed	Yes
Mastoid (Lateral)	12	69	480	1/2	36	Par speed	Yes

ethmoid sinuses are partially developed. The frontal sinus is present only in rudimentary form in the anterior ethmoidal area, while the sphenoid sinus is very small and pneumatization of the sphenoid bone has not yet begun.

PRESENT STUDY

In the present study roentgenograms were made of each infant in (1) the postero-anterior or nose-forehead projection, (2) the maxillary sinus or Waters' position, (3) the occipital, (4) the lateral, and (5) the base or mento-vertical projections. In addition, roentgenograms in the lateral mastoid position were made in approximately one-fourth of all the infants studied. The head was held in position by means of a non-opaque cellulose sponge, so constructed as to form a semicircle which could be placed partially encircling the skull. The technical factors are given in Table II.

An attempt was made to select only healthy infants for this investigation, any with obvious abnormalities being excluded. In general the mothers were also free from disease. In those cases in which there was a history of maternal disease, it was considered to be of the type that would not affect the development of the child *in utero*. This statement is made with reservations in view of the presence of a weakly positive Wassermann reaction in two mothers. Pertinent facts relating to the mothers are given in Table III.

The infant birth weights varied from 5

TABLE III: DATA PERTAINING TO THE MOTHERS
100 NEWBORN INFANTS

BLOOD SEROLOGY

Negative.....
Positive (1 plus).....
Unrecorded.....

MATERNAL MEDICAL HISTORY

Primipara.....
Multipara.....
No previous significant illness.....
Pre-eclamptic toxemia.....
Simple hypertension.....
Treated syphilis.....
Rheumatic heart disease.....
Miscellaneous (hay fever, tubo-ovarian disease, "nervous breakdown," cystitis, pneumonia, questionable tuberculosis).....

TYPES OF PELVES

Gynecoid.....
Android.....
Anthropoid.....
Platypteloid.....
Unrecorded.....

METHOD OF DELIVERY

Spontaneous.....
Breech.....
Vertex.....
Low forceps.....
Version and extraction.....
Cesarean section.....

LENGTH OF LABOR: Range in hours, 1-80

pounds. 1 ounce, for an infant who was four weeks premature, to 9 pounds 4 ounces, for a full-term child. Noted the incidence of births of white babies at this hospital is greater than that of colored but in this group 61 were colored and 39 white. The female babies were in the majority, numbering 53, only 47 males. The ages of 95 ranged from one to ten days, only 5 being between ten and fourteen days of age at the time of

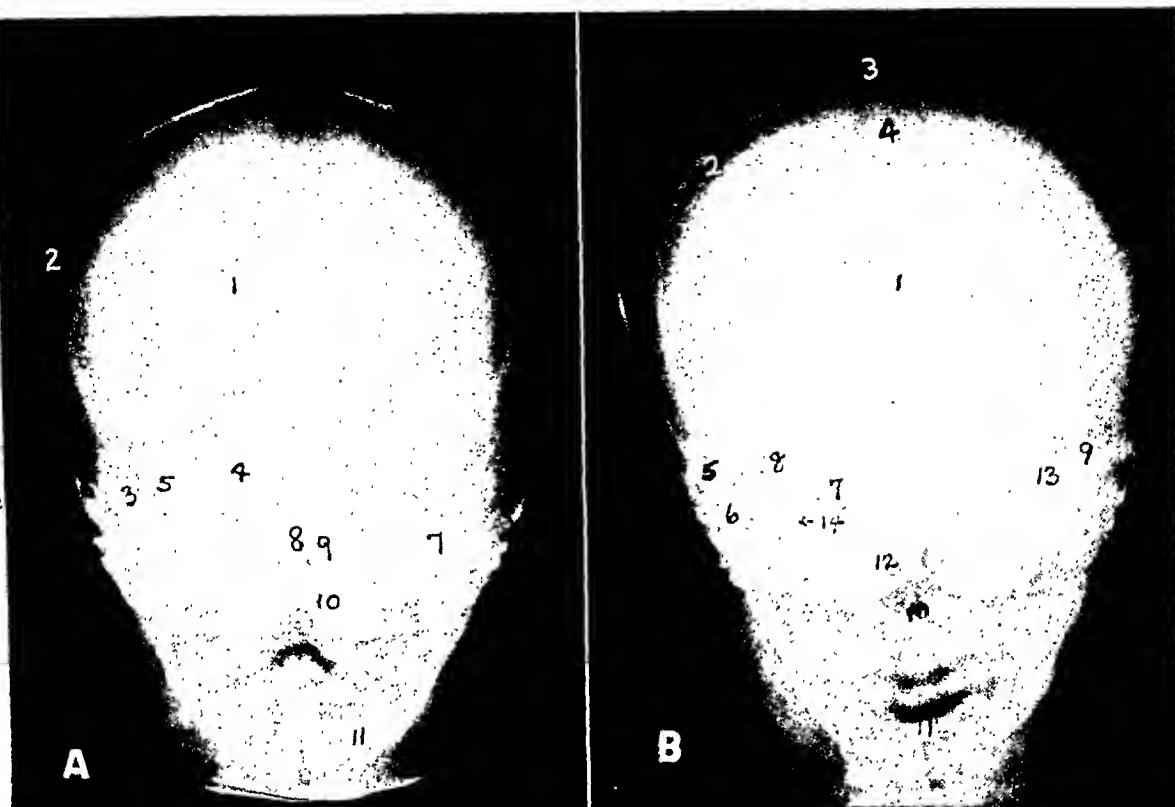


Fig. 1. Postero-anterior view of skull of newborn, nose-forehead position.

A. 1. Frontal. 2. Parietal. 3. Zygoma, frontal process. 4. Sphenoid, lesser wing. 5. Sphenoid, greater wing. 6. Temporal, squamous portion. 7. Petrous pyramid. 8. Nasal septum. 9. Turbinate. 10. Maxilla. 11. Mandible.

B. 1. Metopic suture. 2. Coronal suture. 3. Sagittal suture. 4. Anterior fontanelle. 5. Anterolateral fontanelle. 6. Squamo-sphenoidal suture. 7. Sphenoidal fissure. 8. Spheno-frontal fissure. 9. Zygomatico-frontal suture. 10. Intermaxillary suture. 11. Intermandibular suture. 12. Naris. 13. Arcuate eminence. 14. Superior semicircular canal.

roentgen examination. The period of gestation in 89 cases was nine months. Ten of the babies were two to four weeks premature, the remaining infant being born at the end of seven and a half months' gestation. These data are presented in summary in Table IV.

Skull Measurements: Various diameters of the skull were measured in an attempt to establish a standard for the newborn. As Moloy (5) has indicated, many of the cephalic diameters are changed during molding of the fetal skull, although the total volume may be unaffected. However, even in extreme molding this author says that the mid-petrovertical diameter remains constant.

In the study of this group of infants anteroposterior and vertical height measurements were determined for the hypophyseal fossa. The greatest anteroposterior or occipitofrontal diameter, the greatest breadth, and the greatest height from the foramen magnum to the vertex of the skull were measured. If Schüller's (7) statement has been interpreted correctly, he

TABLE IV: DATA PERTAINING TO 100 NEWBORN INFANTS

BIRTH WEIGHT.....	5 lb. 1 oz. to 9 lb. 4 oz.
RACE.....	
White.....	39
Colored.....	61
SEX.....	
Male.....	47
Female.....	53
AGE.....	
1-10 days.....	95
11-14 days.....	5
PERIOD OF GESTATION.....	
Full-term.....	89
Premature, 2 to 4 weeks.....	10
Premature, 6 weeks.....	1

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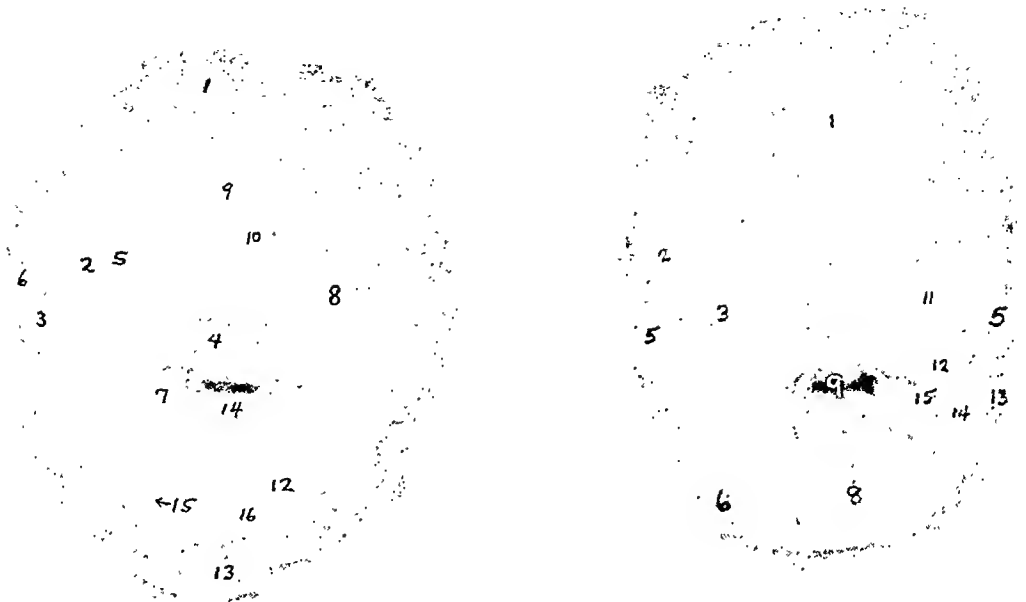


Fig. 2. Postero-anterior view of skull of newborn, maxillary sinus position.

A. 1. Frontal. 2. Zygoma. 3. Arch of zygoma. 4. Sphenoid, body. 5. Sphenoid, greater wing (posterolateral orbital wall). 6. Temporal, squamous portion. 7. Temporal, petrous portion. 8. Mandible. 9. Nasal. 10. Nasal septum. 11. Parietal. 12. Mandible. 13. Occipital, squamous portion. 14. Occipital, basilar portion. 15. Occipital, right lateral portion. 16. Foramen magnum.

B. 1. Metopic suture. 2. Zygomatico-frontal suture. 3. Zygomatico-maxillary suture. 4. Squamoso-parietal suture. 5. Squamo-sphenoidal suture. 6. Lambdoid suture. 7. Coronal suture. 8. Inter-mandibular suture. 9. Spheno-occipital suture. 10. Anterolateral fontanelle. 11. Infra-orbital foramen. 12. Foramen ovale. 13. Mastoid antrum. 14. Fenestra vestibuli. 15. Porus acusticus internus.

takes the greatest breadth of the skull to be in the bitemporal diameter. In this group, the greatest breadth was found to be in the biparietal diameter, and measurements of the skull were made accordingly. Multiplication of the length, height, and breadth gives a figure which may be taken to represent roughly the skull volume. This, of course, is not the true skull volume, but, as will be seen, the figure obtained is satisfactory for comparison with the birth weight.

Anteroposterior diameters of the sella turcica varied between 4.0 and 6.5 mm., the average figure being 5.2. In depth, the range was between 1.5 and 3.5 mm., with an average of 2.5. Considerable variation was noted in the occipitofrontal diameter, the breadth, and the vertical

height of the skull in different infants. The average vertical height was 10.18 cm., the average occipitofrontal diameter, 12.5 cm., and the average breadth, 10.2 cm. The average figure for the approximate skull volume, as determined above, was 1,275 c.c. As will be noted in Table I, there is only a slight difference in these average figures for the colored and for the white babies.

Relation of Size of Infant Skull to Birth Weight: It seems to be a fairly general belief that the size of the fetal skull as determined by cephalopelvimetric study can be used as an indicator of the over-all fetal size. The present investigation gave an opportunity for determining the accuracy of this belief. The skull volume, computed as previously described, was

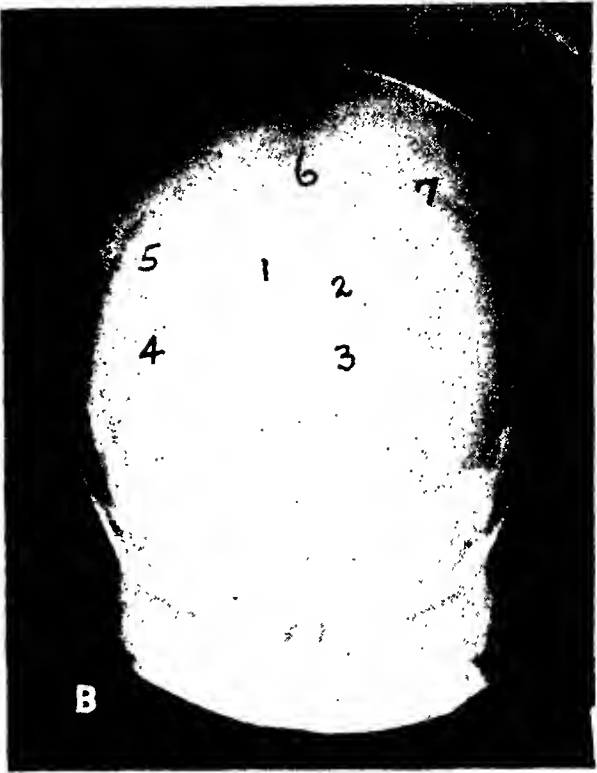


Fig. 3. Occipital view of skull of newborn.

- A. 1. Occipital, squamous (intramembranous) portion. 2. Occipital, squamous (cartilaginous) portion. 3. Occipital, right lateral portion. 4. Parietal. 5. Temporal, petrous portion. 6. Lambdoid suture. 7. Coronal suture. 8. Remnant of fissure between two halves of interparietal portion of occipital. 9. Remnant of fissure between interparietal and supra-occipital portions of occipital bone. 10. Fissure between squamous and lateral portions of occipital. 11. Posterior fontanelle. 12. Anterior fontanelle. 13. Posterolateral fontanelle. 14. Foramen magnum. 15. Mastoid antrum. 16. Porus acusticus internus. 17. Superior semicircular canal. 18. Arcuate eminence.
- B. 1. Anomalous intramembranous occipital center of ossification. 2. Fissure between main intramembranous portion of squama occipitalis and anomalous occipital center of ossification. 3. Main intramembranous portion of squama occipitalis. 4. Future lambdoid suture. 5. Parietal. 6. Posterior fontanelle (shadow superimposed upon that of anterior fontanelle). 7. Future coronal suture.

compared with the birth weight. No direct relation could be found. For example, the smallest infant in the series,

SKULL VOLUME (L X B X H; not actual volume)		
Entire series (100 infants).....	917-1563 c.c.	1275 c.c.
Colored (61 infants)...	917-1531 c.c.	1277 c.c.
White (39 infants)....	1105-1563 c.c.	1273 c.c.

SEPARATION OF CRANIAL BONES

Future lambdoid suture	
Lateral view.....	1.5-10.0 mm.
Occipital view.....	3.0-11.0 mm.
Future coronal suture	
Lateral view.....	1.5 to 11.0 mm.
Future sagittal suture	
Occipital view.....	3.0 to 17 mm.

BASE ANGLE

Angle between squamous portion of occipital below superior nuchal line and base of skull anterior to occipital squama....	100-125°	112°
---	----------	------

four weeks premature, weighing 5 pounds 1 ounce at birth, had a skull volume of 1,366 c.c., while a large full-term infant, weigh-

TABLE V: MEASUREMENTS OF INFANT SKULL

	Range	Average
BELLA TURCICA (100 infants)		
Anteroposterior diameter.....	4.0-6.5 mm.	5.2 mm.
Depth.....	1.5-3.5 mm.	2.5 mm.
SKULL DIAMETERS		
Entire group (100 infants)		
Anteroposterior.....	10.6-13.8 cm.	12.5 cm.
Vertical height.....	9.0-13.1 cm.	10.18 cm.
Breadth.....	9.0-11.2 cm.	10.2 cm.
Colored (61 infants)		
Anteroposterior.....	10.6-13.8 cm.	12.51 cm.
Vertical height.....	9.0-13.1 cm.	10.12 cm.
Breadth.....	9.0-11.2 cm.	10.1 cm.
White (39 infants)		
Anteroposterior.....	11.7-13.5 cm.	12.48 cm.
Vertical height.....	9.1-11.2 cm.	10.25 cm.
Breadth.....	9.2-11.0 cm.	10.3 cm.

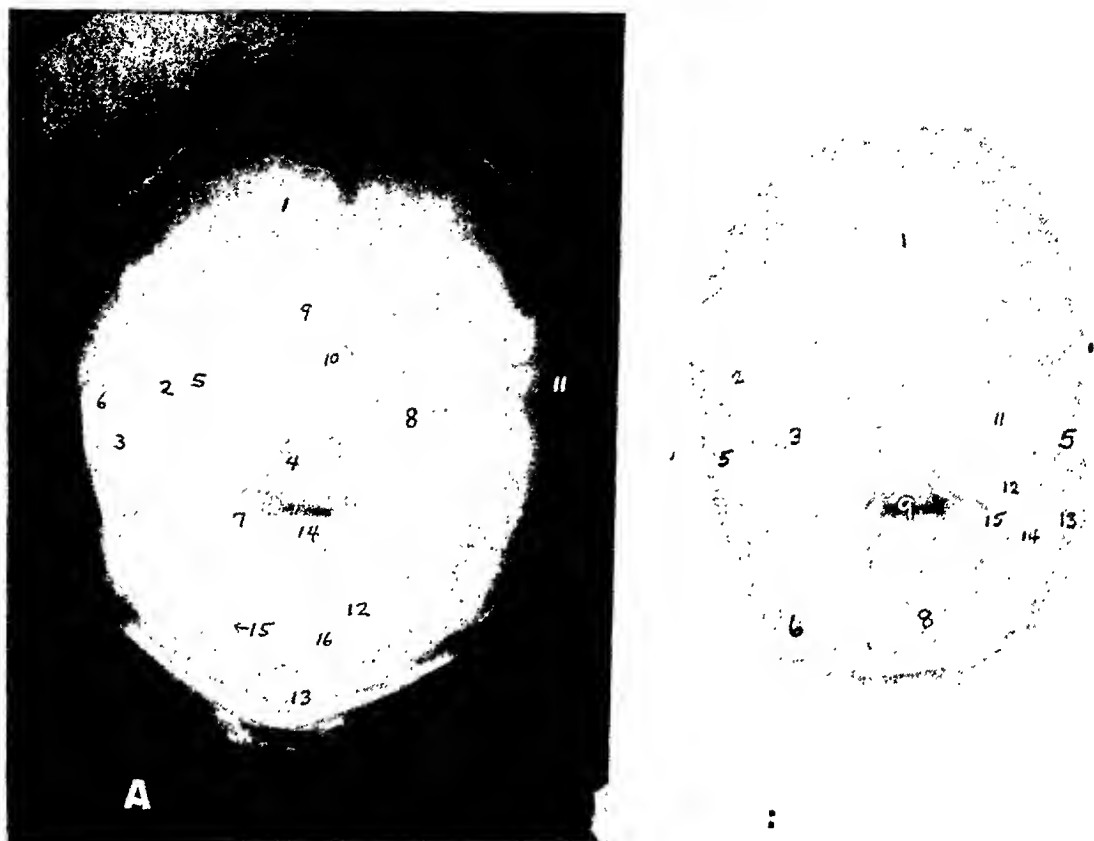


Fig. 2. Postero-anterior view of skull of newborn, maxillary sinus position.

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B. 1. Metopic suture. 2. Zygomatico-frontal suture. 3. Zygomatico-maxillary suture. 4. Squamoso-parietal suture. 5. Squamo-sphenoidal suture. 6. Lambdoid suture. 7. Coronal suture. 8. Inter-mandibular suture. 9. Spheno-occipital suture. 10. Anterolateral fontanelle. 11. Infra-orbital foramen. 12. Foramen ovale. 13. Mastoid antrum. 14. Fenestra vestibuli. 15. Porus acusticus internus.

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Relation of Size of Infant Skull to Birth Weight: It seems to be a fairly general belief that the size of the fetal skull as determined by cephalopelvimetric study can be used as an indicator of the over-all fetal size. The present investigation gave an opportunity for determining the accuracy of this belief. The skull volume, computed as previously described, was

found in the mesocephalic skull, above 80 in the brachycephalic, and below 70 in the dolichocephalic.

It is interesting to note that the only infant in this series with a dolichocephalic head (see Table VI) was born by cesarean section, with no preceding maternal labor. The large number of brachycephalic skulls in this group of cases—53—is probably misleading. Obviously the forces of labor would tend to change the configuration of the skull at birth, and the abnormal shape seen after a long molding process tends to disappear after the first few days of post-natal life. On the other hand, the highest linear indices were not seen in those cases in which maternal labor was longest. When, however, one considers the large number of colored babies in this group, it seems more than ever evident that molding must account for much of the brachycephaly seen here. von Török (8) designated the Negroes, among others, as a manifestly dolichocephalic race. Schüller (7) says that we do not know why certain races are dolichocephalic and others brachycephalic, but that the fact has been mentioned that every race, with the progress of culture, has the tendency to become brachycephalic.

Miscellaneous Findings: In Table VII there are grouped miscellaneous observations noted on examination of the infant skull roentgenograms in this series. Several of these findings are deserving of brief comment.

A persistent anomalous bone (the posterior interparietal or Inca bone) in the adult is not a common finding, but in 18 of these infants there were definite posterior fontanelle or anomalous occipital centers of ossification. Some were quite large. One in particular was striking in appearance, the impression given being that of a bone fragment broken sharply off the adjacent occipital.

Pancoast, Pendergrass, and Schaeffer (6) state that: "In infants the bones of the skull present roentgenographically a relatively homogeneous appearance, which is in sharp contrast to the irregular areas of

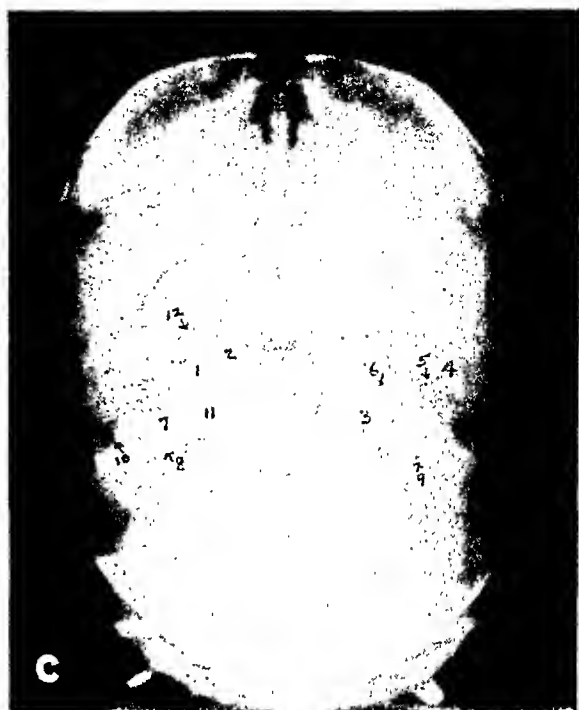


Fig. 4, C. Base view of skull of newborn.

1. Carotid canal. 2. Internal carotid foramen.
3. External carotid foramen. 4. Tympanic ring and external auditory meatus. 5. Ossicles. 6. Cochlea.
7. Fenestra vestibuli. 8. Facial canal. 9. Stylo-mastoid foramen. 10. Mastoid antrum. 11. Porus acusticus internus. 12. Foramen ovale.

TABLE VII: MISCELLANEOUS FINDINGS ON EXAMINATION OF THE NEWBORN SKULL

	Incidence (100 Infants)
Posterior fontanelle bones.....	15
Anterolateral fontanelle bones.....	10
Sutural bones.....	51
Separate occipital centers of ossification.....	3
Vascular markings in frontal.....	44
Convolutional (?) markings in parietal..	26
Markings due to folds of scalp.....	33
Radiating striate markings of parietal... (Due to manner in which bone is laid down?)	3
Cleft in posterior half of parietals..... (Residual embryonal cleft)	1
Parieto-occipital flattening..... (Due to molding in labor, or to resting on hard bony surface of maternal pelvis?)	23
Upward displacement of squama occipitalis.....	5
Upward bulge of parietal bones.....	10
Apparent ethmoidal cells.....	12
Deviation of nasal septum from mid-line	11

rarefaction and increased density seen in the adult skull. . . . The bones of the infant skull do not contain so much inorganic material as adult bones, and, also, lack a diploic structure. Furthermore, the vari-

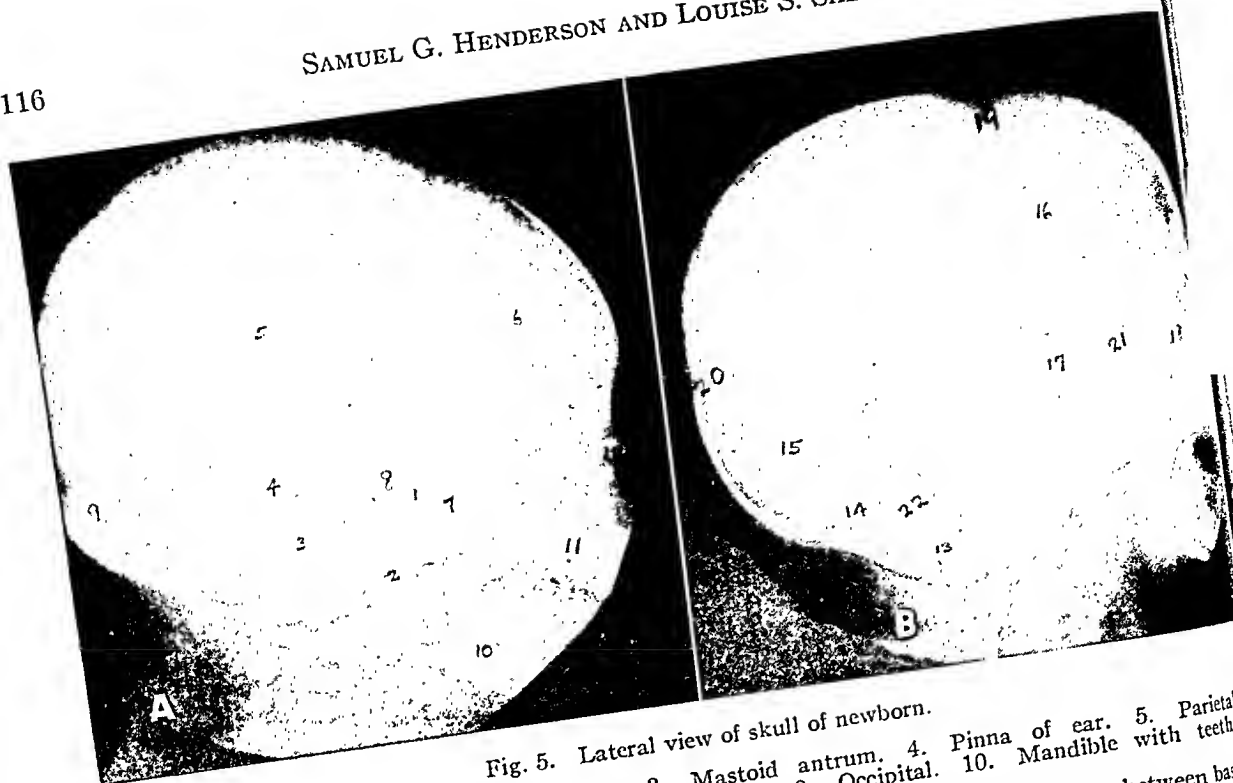


Fig. 5. Lateral view of skull of newborn.

- A. 1. Sella turcica. 2. Tympanic ring. 3. Mastoid antrum. 4. Pinna of ear. 5. Parietal Frontal. 7. Sphenoid. 8. Temporal, squamous portion. 9. Occipital. 10. Mandible with teeth. Maxilla with teeth. 12. Nasal bone.
- B. 13. Junction of squamous and lateral portions of occipital. 14. Remnant of fissure between basal interparietal portions of occipital squama. 15. Lambdoid suture. 16. Coronal suture. 17. Squamous suture. 18. Fronto-ethmoidal suture. 19. Anterior fontanelle. 20. Posterior fontanelle. 21. Anterolateral fontanelle. 22. Posterolateral fontanelle.

ous vessel grooves and ridges, commonly seen in the adult, are not sufficiently well marked during infancy to show in the roentgenogram."

While vascular markings could not be distinguished in the parietal bones in any of the babies studied in this investigation, yet in 44 of the group there were distinct vascular shadows in the frontal bones. The presence of convolutional impressions is a debatable point. Areas of lessened density which we believe represent convolutional markings were seen in the parietal bones in 26 infants. It is conceded, however, that these shadows may be due to variations in bone thickness intrinsic in the way in which bone is laid down in membrane.

Some degree of parieto-occipital flattening was seen in 23 babies. As stated previously, Mueller (7) believes that variation in skull shape may be brought about through long continued resting of the fetal head upon the pelvic inlet in cases in which the amniotic fluid is scanty. He admits,

however, the effect of the forces of labor in further shaping the skull. Upward displacement of the basal portion of the squama occipitalis, seen in 5 cases, might be due to a combination of these factors. On the other hand, an appearance as of upward bulging in the parietal area, noted in 10 infants, is probably due entirely to fetal head molding during labor.

Development of the nasal accessory sinuses in the infant and young child is discussed by Camp (2), Tremble (9), and Wasson (11). Tremble (9) also describes the process of pneumatization of the temporal bone. The ethmoid and maxillary sinuses and the sphenoid sinuses in the presphenoid area are partially developed at birth, but the time at which they first become aerated is uncertain. Tremble (10) says that the mastoid antrum is practically always present at birth, even in cases in which the external meatus and auricle are undeveloped. He quotes Cheate to the effect that this is not the only cell to be seen at the time of birth.

The lateral wall of the antrum is studded with minute cells which enlarge as the mastoid process grows.

Although roentgen examinations in the maxillary sinus position were made in all of these infants, detailed study failed to show any conclusive evidence of maxillary sinuses on the films. On the other hand, in 12 infants small radiolucent shadows were seen medial to the orbital shadows which were believed to be due to small aerated ethmoid cells. No evidence of frontal or sphenoid sinuses could be seen. In all of the infants in whom the mastoids were examined, a well developed mastoid

SUMMARY

Roentgen examinations of the skull were made in a group of 100 healthy newborn infants. Postero-anterior, lateral, occipital, mento-vertical, and maxillary sinus positions were used in all cases, and a sufficient number of studies of the lateral mastoid region was made to obtain familiarity with the appearance of this part of the skull. The technical factors used in the examinations have been listed.

The embryological development of the skull is reviewed briefly.

Measurements of the *sella turcica*, of the

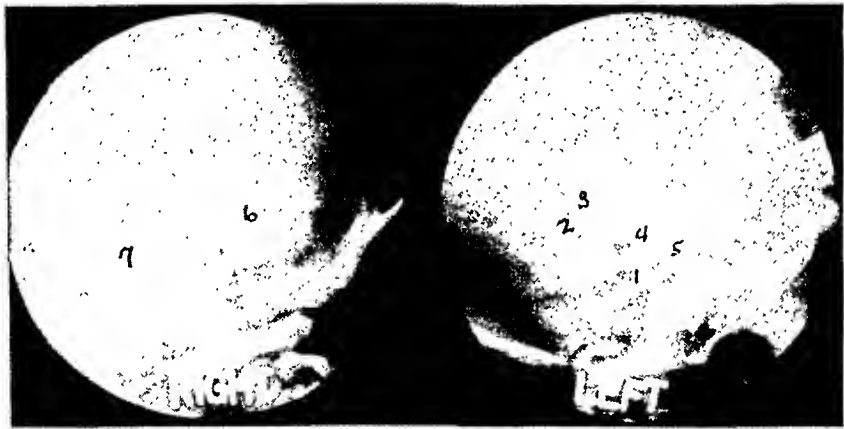


Fig. 6. Lateral mastoid view of skull of newborn.

1. Tympanic ring. 2. Mastoid antrum. 3. Tegmen tympani. 4. Porus acusticus internus. 5. Internal carotid foramen. 6. Superior semicircular canal. 7. Sella turcica.

antrum was found. An interesting finding in connection with the upper air passages was some deviation of the nasal septum from the mid-line in 11 cases.

A detailed survey of the roentgenograms made in the various positions previously described and concomitant study of the skull of a newborn infant permitted identification of many structures which had been hitherto more or less unrelated parts of a puzzle. In the hope that mapping of these various parts may be of interest and of some assistance in infant skull interpretation, several roentgenograms are presented, the various recognizable areas being indicated by numbers with accompanying legends.

various skull diameters, of the degree of separation of the cranial bones, and of the angle between the squamous portion of the occipital below the superior nuchal line and the base of the skull anterior to the occipital squama were made.

Average diameters in millimeters for the sella turcica were: anteroposterior, 5.2; depth, 2.5. Average skull diameters in centimeters were: anteroposterior, 12.5; vertical height, 10.18; breadth, 10.2.

Determination of the linear index as described by Schüller revealed a preponderance of brachycephalic skulls in this group, presumably due in part to molding of the head during labor.

No direct relation could be found be-

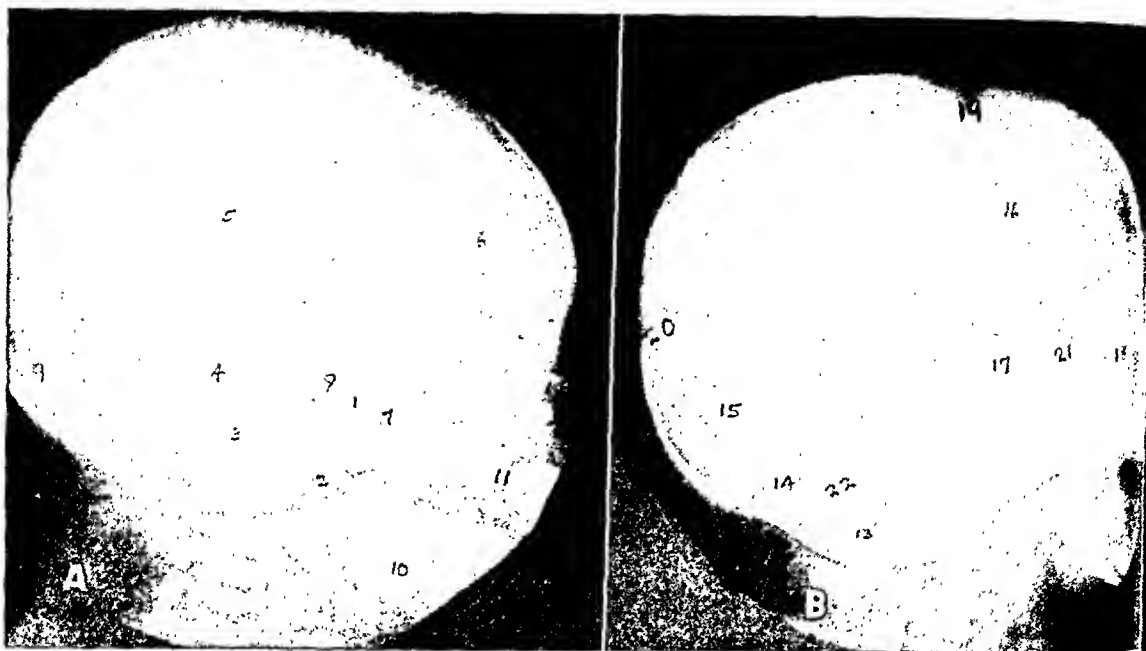


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Mid-Line Anomalies of the Brain: Their Diagnosis by Pneumoencephalography¹

ARTHUR P. ECHTERNACHT, M.D.,² and JOHN A. CAMPBELL, M.D.³

Indianapolis, Ind.

IN THE MID-LINE of the brain are situated two anatomical structures that may be involved by rare developmental anomalies. They are the septum pellucidum and the corpus callosum.

From August 1942 to August 1944, pneumoencephalograms or ventriculograms were made on 96 patients of the Indiana University Medical Center. In 6 cases congenital cysts of the septum pellucidum were demonstrated and in 2 cases agenesis of the corpus callosum was found. A review of the available literature has revealed 15 cases of the former anomaly and 18 of the latter that were diagnosed by encephalography.

Rarity as a quality of any abnormal condition has and always will incite the interest of the physician. It is such a stimulus that has prompted our presentation of this paper. The anomalies described will be presented separately for clarity.

CYSTS OF THE SEPTUM PELLUCIDUM

Practically all anatomy books describe the cavum septi pellucidi and cavum vergae. The former is better known as the fifth ventricle and the cavum vergae has been called the sixth ventricle. The cavum septi pellucidi has been known at least since the time of Sylvius. The cavum vergae is named for Andrea Verga, who described it in 1851. However, according to Dandy (1), Ferrario was the first to publish his observations of this structure. These cavities are obviously not a portion of the ventricular system. They have a different embryonic derivation, are not lined by ependyma, and only under ab-

normal conditions do they communicate with the ventricles.

The septum pellucidum is a thin, somewhat triangular, two-leaved membrane, which separates in a vertical plane portions of the two lateral ventricles. It is found within the confines of the corpus callosum. The two cavities which we are now discussing are not independent. When both are present, they usually communicate and, from the developmental standpoint, the cavum vergae is simply the posterior portion of the cavum septi pellucidi.

The cavum septi pellucidi has the following boundaries: anteriorly, the genu of the corpus callosum; superiorly, the body of the corpus callosum; posteriorly, the anterior limb and the pillars of the fornix; inferiorly, the rostrum of the corpus callosum and the anterior commissure; laterally, the leaves of the septum pellucidum.

The cavum vergae is bounded as follows: anteriorly, by the anterior limb of the fornix; superiorly, by the body of the corpus callosum; posteriorly, by the splenium of the corpus callosum; inferiorly, by the psalterium and hippocampal commissure, the fibers of which bridge the space between the diverging posterior pillars of the fornix; laterally, by the leaves of the septum pellucidum.

There are two theories as to the origin of these cavities. One, supported by Thompson (2), holds that the rapid widening of the lamina terminalis during the third month of fetal development causes an internal tension with the resultant formation of a cavity within its substance.

¹ Including ventriculography.

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This paper was read before the Joint Meeting of the American Roentgen Ray Society and the Radiological Society of North America, Chicago, Ill., Sept. 24-29, 1944.

According to the other theory, the cavity is a part of the interhemispheric fissure whose lateral boundaries are the medial aspects of the cerebral vesicles ventral to the caudally extending corpus callosum. Corning (3) supports this theory. He believes that the cavity reaches back to the splenium in the seventh fetal month and that from the eighth to the ninth fetal month the caudal end of the cavity is gradually obliterated by the union of the floor with the corpus callosum. He contends that this explains the much higher frequency of a patent cavum septi pellucidi without a cavum vergae.

Wolf and Bamford (4) also favor the latter theory. They call attention to the constancy with which the structure of the cavum septi pellucidi is produced and find it difficult to imagine a varying tension within the lamina terminalis producing such a uniform result.

There has been much debate as to whether the communications that sometimes exist between these cavities and the lateral or third ventricles are normal or artificial. Dandy, among others, believed them to be artificial because their borders are ragged and shreds of tissue can be seen hanging from the sides of the orifices, and they are inconstant in position, size, and number. It would appear that, if these openings were normal, they would exist in all cysts of the cavum septi pellucidi or cavum vergae.

There has been no satisfactory explanation given for the source of the fluid that forms in these cavities.

Dandy, and Van Wagenen and Aird (5) have described three types of dilatation of the cavum septi pellucidi and the cavum vergae:

1. Non-communicating type, in which the walls of the cavity are intact.
2. Communicating type, in which an opening or openings exist between the cavity and the lateral or third ventricles, caused by rupture when the intracystic tension becomes too great.

3. Acquired or secondary type, as a part of a later developing internal hydrocephalus.

The non-communicating types are of clinical significance because they may obstruct the interventricular foramina, with resultant increased intracranial pressure and associated signs and symptoms. Their diagnosis, however, depends upon encephalography or ventriculography.

Meyer (6), in 1930, was the first to report the diagnosis of a non-communicating cyst of the septum pellucidum by encephalography. Dandy, in 1931, first described a case diagnosed by ventriculography. Dyke (7) stated that this type of anomaly is extremely rare. He found only one well established case in 5,000 encephalograms.

The communicating type of cyst may not produce clinical symptoms. In most cases, however, convulsive seizures occur, and it should be noted that few patients have encephalographic studies without some evidence of intracranial disturbance.

Pendergrass and Hodes (8) were the first to give a detailed description of the encephalographic appearance of cysts of the cavum septi pellucidi and cavum vergae. The septum pellucidum can be seen only in the anteroposterior or postero-anterior projection of the skull, following the satisfactory filling of the lateral ventricles with a gas. It appears as a thin vertical density separating the lateral ventricles. Its normal width is 1.5-3.0 mm. The slightest widening of the septum pellucidum should lead one to suspect a cyst of this structure. Pendergrass and Hodes emphasize the importance of a careful search for slight changes in the density of the air shadow in the ventricles close to the septum, which might easily be overlooked.

In the non-communicating type there is usually a dilatation of the ventricular system, particularly one or both lateral ventricles, due to obstruction of one or both interventricular foramina and/or the aqueduct of Sylvius.

The lateral ventricles are separated by the mass of the cyst. The filling defect

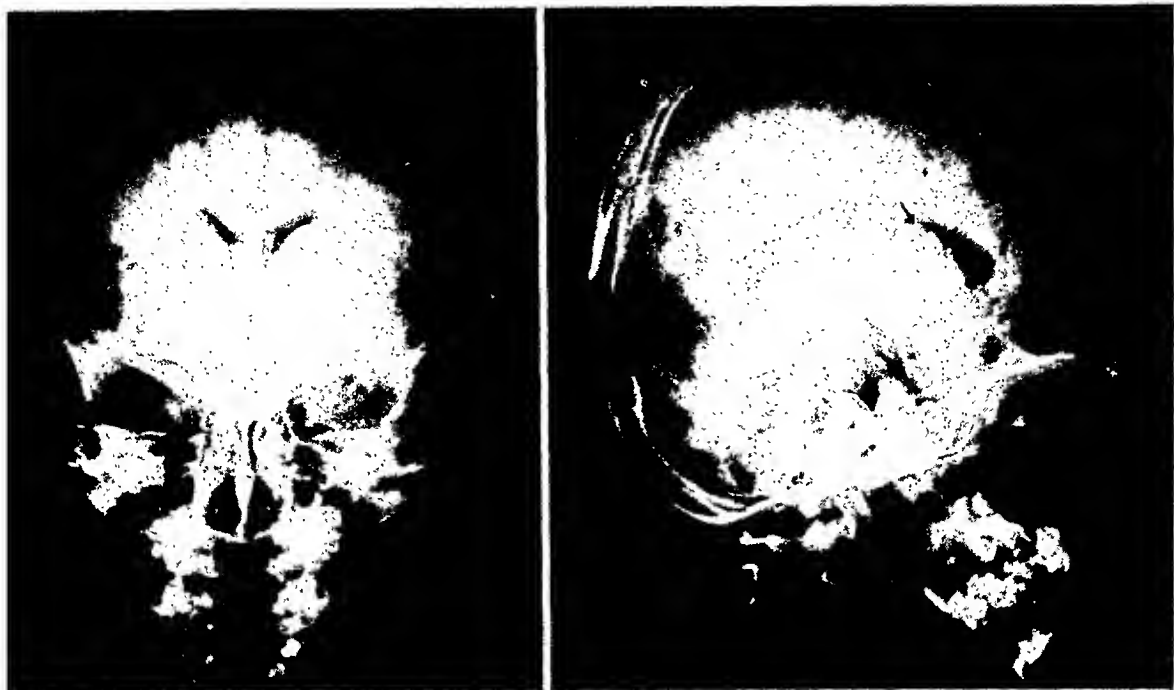


Fig. 1. Case 1: Widening of the septum pellucidum measuring 5 mm. in the sagittal view. Density (arrows) superimposed on the bodies and anterior horns of the lateral ventricles in the lateral projection.

may be bilaterally symmetrical or more pronounced on one side than the other. The third ventricle may be depressed by the distended cyst. If calcified, the pineal gland may be seen to be displaced downward.

In the lateral view, the non-communicating cysts are seen as areas of increased density superimposed upon the bodies of the lateral ventricles. This shadow, if produced by a cyst of the cavum septi pellucidi, is comma-shaped, having its greatest diameter anteriorly and tapering to a blunt point posteriorly. If the cyst is of the cavum vergae, its shadow should be located more posteriorly than that of the cavum septi pellucidi and is oval or bean-shaped. When both cysts occur, they appear in the lateral view as a somewhat hourglass-shaped area of density, the waist of the shadow being the point of connection of the two cysts.

Cavum septi pellucidi of the communicating type appears in the sagittal projections as an air-containing space separating the lateral ventricles. The two leaves of the septum pellucidum are clearly seen as linear densities separating the air of the

cavity from that in the ventricles. The roof of the cavity is about at the level of the lateral ventricles at their medial aspect. The floor of the cavity is usually on the same level as the floor of the bodies of the lateral ventricles.

In the lateral view, the cavum septi pellucidi might easily escape detection if it were not seen in the sagittal projections, because of its superimposition on the anterior horns and bodies of the lateral ventricles. It may easily be mistaken for a small amount of air in the opposite ventricle. It has a comma shape. The anterior border does not extend as far forward as the anterior horns of the lateral ventricles. Its tapering posterior limit approaches a point above the junction of the aqueduct of Sylvius and the third ventricle.

A cavum vergae of the communicating type appears the same as the cavum septi pellucidi in the sagittal projections, except that it may be somewhat smaller and it extends under the lateral ventricles with the curve of the fornix. In the lateral projection it is seen as a radiolucent area, oval in shape, extending for 1-2 cm. in its longest diameter back from the usual pos-



Fig. 2. Case 2: Widening (6 mm.) of the septum pellucidum in the sagittal projection. Density (arrows) superimposed on the anterior horns and anterior portions of the lateral ventricles in the lateral view.

terior limit of the cavum septi pellucidi. When both cavities are present, the radio-lucent area is roughly hourglass in shape.

Congenital cysts of the septum pellucidum of the communicating type are easily diagnosed if satisfactory films are obtained and studied carefully. They may be mistaken for the third ventricle due to superimposition. Cysts of the non-communicating type, however, may be simulated by a variety of lesions, some of which deserve mention. They are (1) solid tumors of the septum pellucidum, (2) lesions of the corpus callosum, (3) tumors of the lateral ventricles arising from the medial wall, (4) mid-line lesions in the frontal region, (5) third ventricle lesions, (6) pinealomas, and (7) meningiomas of the olfactory groove.

Case Reports

CASE 1: B. F., a four-and-a-half-year-old white girl, was admitted to the hospital on Aug. 28, 1942, because of convulsions, loss of weight, and a peculiar gait. The first convulsion occurred in June 1941 and was reported to have lasted for over an hour. According to the description, the attack was a typical grand mal seizure. There had been seven such attacks since the initial one.

Physical examination was essentially negative ex-

cept for the fact that the child walked with a slight inversion of the right foot and some footdrop was also noted on that side. Blood, urine, and spinal fluid examinations were negative. Encephalograms made on Sept. 14, 1942, were reported as normal. The patient was discharged to the Cerebral Palsy Clinic as an epileptic and cerebral spastic.

Psychometric tests on May 24, 1944, showed an average range of intelligence with a mental age between five and eight years and an I.Q. of 90. The patient continues to require maintenance doses of sedative drugs for convulsive seizures.

Comment: This case was not recognized until the films were surveyed in preparation of this paper. A widening of the septum pellucidum, which measures 5 mm., is readily seen. We believe that the density identified by the arrows anteriorly in the lateral view localizes this as a cyst of the cavum septi pellucidi (Fig. 1).

CASE 2: J. J. J., a four-year-old white male, was admitted to the hospital on Jan. 20, 1943. He had always had difficulty in walking. He had been seen in the Orthopedic Clinic in 1940, at which time he was referred to the Spastic Clinic for instructions and exercises. He was also seen in the Neurological Clinic, and hydrocephalus was suspected.

Physical examination showed the circumference of the head to be 57 cm. The patellar and ankle jerks were hyperactive. The patient walked unsteadily on the toes, with both feet in equinus posi-



Fig. 3. Case 3: Dense filling defects with convex lateral borders in the bodies of the lateral ventricles, apparently arising from their medial walls seen in the sagittal projection. Comma-shaped density (arrows) superimposed upon the bodies and posterior portions of the anterior horns of the lateral ventricles and lack of filling of the aqueduct and fourth ventricle in the lateral view.

tion. All laboratory tests were negative. Encephalograms made on Jan. 25, 1943, were reported as normal.

The patient was discharged on Jan. 28, 1943, to be followed in the outpatient clinic. The diagnosis on discharge was cerebral spastic paralysis.

Comment: This case was also missed until a review of the films in preparation for this paper revealed widening of the septum pellucidum, evidence of a non-communicating cyst of the cavum septi pellucidi (Fig. 2).

CASE 3: A. L., a 29-year-old white male, was admitted to the hospital on May 1, 1943, complaining of severe headaches and poor vision. For the past three months he had had numerous attacks of vomiting, severe headache, usually frontal, dizziness, failing vision, fainting spells, and an occasional convulsion.

On admission, the physical examination showed swelling of the optic nerve heads of 5 diopters. Ventriculography on May 13, 1943, revealed a dense filling defect in the medial walls of both lateral ventricles, with widening of the shadow of the septum pellucidum (Fig. 3). There was also a rounded filling defect in the floor of the third ventricle. The third and lateral ventricles were dilated. The fourth ventricle was not visualized. The diagnosis was tumor of the midbrain with obstruction of the aqueduct of Sylvius and internal hydrocephalus. Repeat ventriculograms made on June 14, with the

patient erect, revealed a large communicating cyst of the cavum septi pellucidi and cavum vergae (Figs. 4 and 5).

The patient's condition failed to improve; he became comatose and died on June 23, 1943.

Autopsy: Examination of the brain after fixation in formaldehyde showed the superior portion of the midbrain replaced by a fairly sharply outlined, somewhat spongy, disk-shaped mass measuring approximately 25 mm. in the vertical diameter and 10 mm. in the horizontal. The mass pushed superiorly and posteriorly to compress the aqueduct, thus leading to dilatation of the lateral and third ventricles. In addition, there was a large cyst-like structure lying in the mid-line, above the third ventricle. This cavity represented a posterior extension of the cavum septi pellucidi and extended to the posterior commissure of the corpus callosum or splenium. It measured 65 mm. in length, 12 mm. in the vertical diameter at the posterior limit, and 25 mm. in the anterior portion. The lateral walls were stretched and thin. There was a defect, presumably due to puncture by the ventricular trocar, in each lateral wall (Fig. 6).

Comment: The non-communicating cyst of the cavum septi pellucidi and cavum vergae were overlooked in the first ventriculograms until the second examination, at which time the walls were apparently ruptured by the trocar. In the sagittal view of the second examination (Fig. 4)

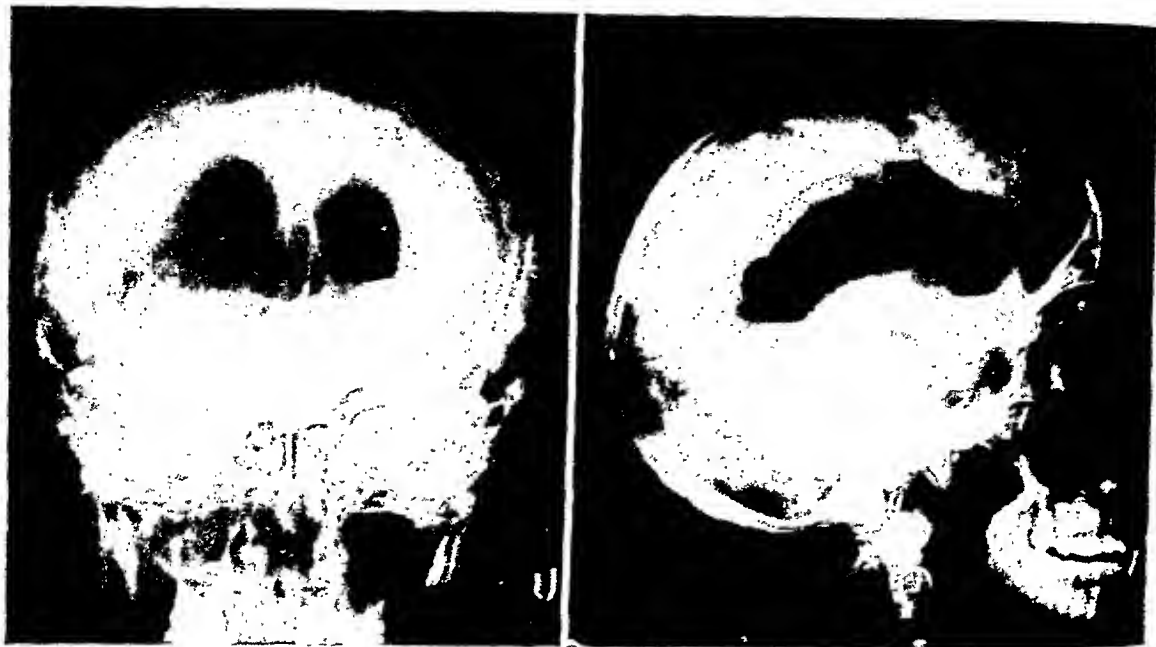


Fig. 4. Case 3: Air outlining the broad slit-like cavum septi pellucidi and triangular cavum vergae in anterior view. Comma-shaped radiolucent area corresponding to position of septum pellucidum in lateral projection. Note fluid levels in both views.

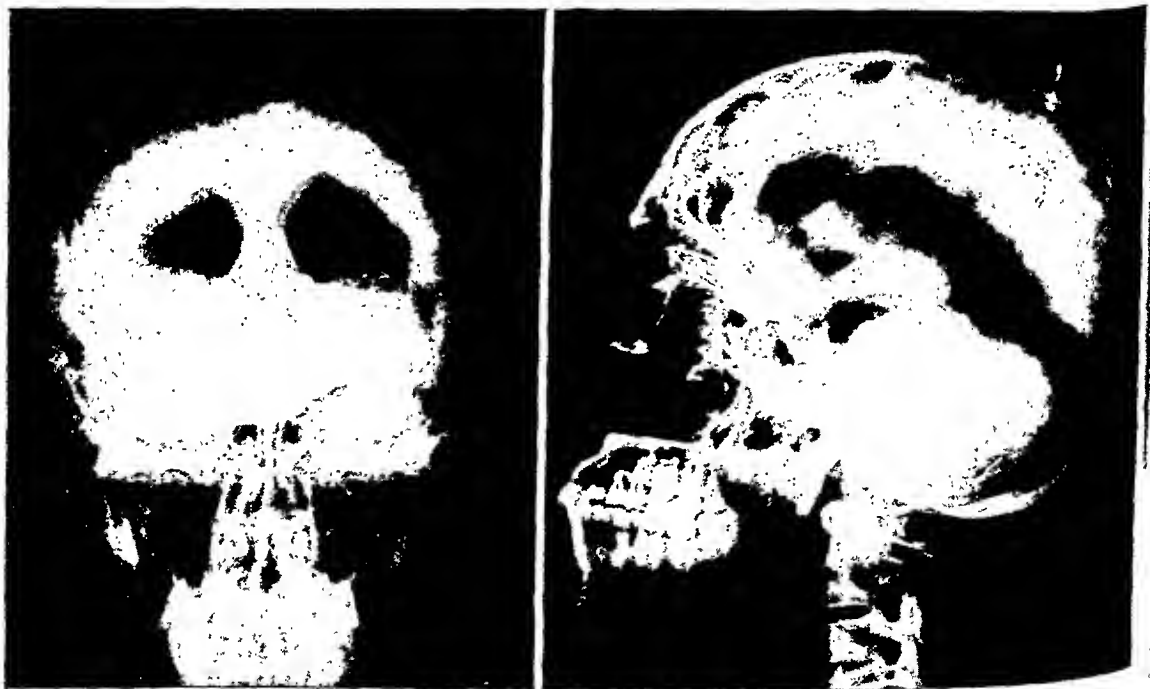


Fig. 5. Case 3: Same findings as in Fig. 4. Note in the sagittal view how the cavum vergae extends underneath the lateral ventricles with the curve of the fornix. Hydrocephalus of the lateral and third ventricles.

the cavum vergae is seen flaring out laterally beneath the lateral ventricles with the curve of the fornix. We believe that this finding is an aid in differentiating between a cyst of the cavum vergae and of the cavum septi pellucidi.

CASE 4: J. J.,⁴ a two-year-old white female, was admitted to the hospital on Dec. 13, 1943, because of a hydrocephalus, noticed shortly after birth, and of abnormal weakness of the lower limbs. The phys-

⁴ We wish to acknowledge the courtesy of Dr. Robert L. Glass, who has kindly permitted us to report this case.

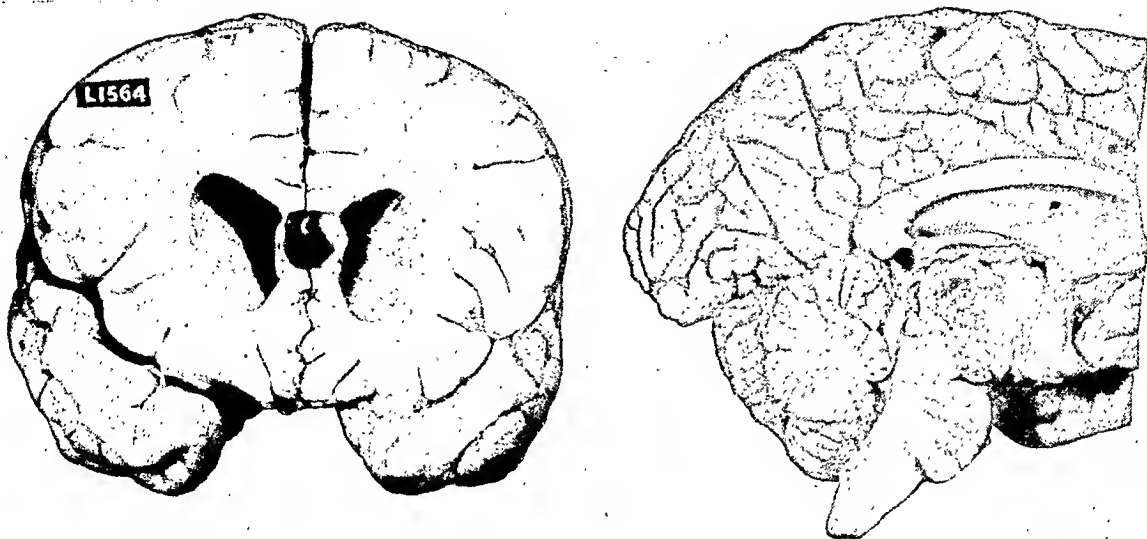


Fig. 6. Case 3: Autopsy specimen. Note wide separation of the leaves of the septum pellucidum in the coronal section. The medial view reveals the tumor in the midbrain compressing the aqueduct of Sylvius and the defect in the right leaf of the septum pellucidum, presumably produced by the ventricular trocar.

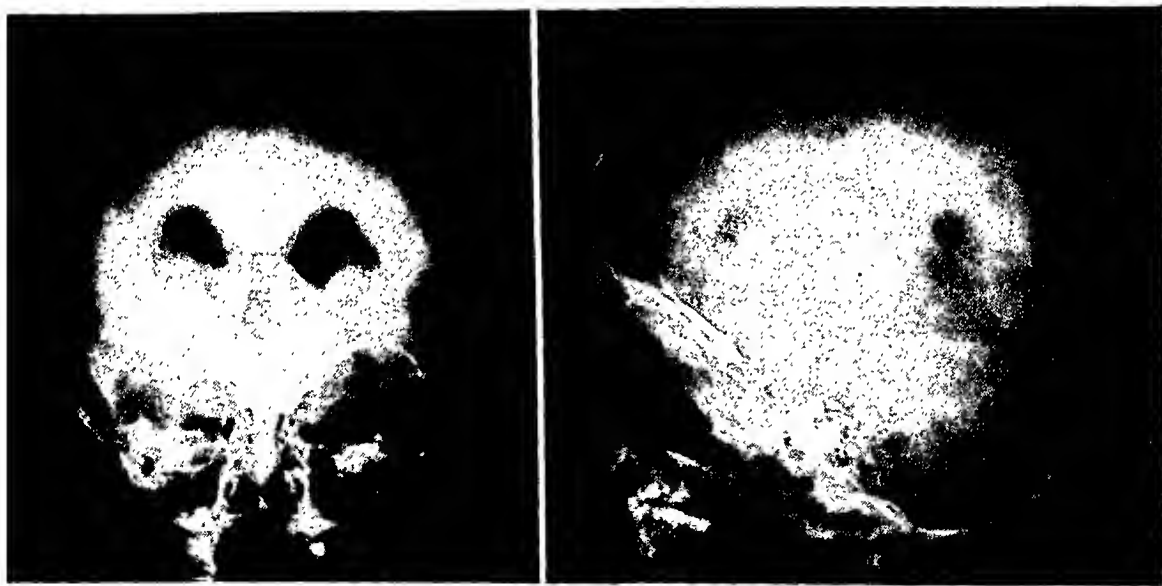


Fig. 7. Case 4: Communicating cyst of the cavum septi pellucidi clearly seen in both views. Hydrocephalus especially marked in posterior portions of the lateral ventricles.

cal examination was essentially negative. Blood, urine, and spinal fluid findings were normal. An encephalographic examination was attempted on Dec. 14, but the ventricles were not demonstrated. Ventriculograms made on Dec. 20 revealed a communicating cyst of the cavum septi pellucidi and internal hydrocephalus (Fig. 7). The patient was discharged improved on Dec. 24. Dr. Glass reports that she has been observed in his office since and has continued to show signs of improvement.

Comment: This may represent another case of a non-communicating cyst made communicating by the introduction of a ventricular trocar through its wall.

CASE 5: J. J. M., a white male infant of two months, was admitted on April 22, 1944, having had several convulsions daily for three days prior to admission. He had been a premature baby, weighing



Fig. 8. Case 5: Communicating cyst of the cavum vergae (arrows) and non-communicating cyst of the cavum septi pellucidi (widened septum in the sagittal view).

4 pounds 13 ounces at birth. On admission he weighed 8 pounds. The physical examination was essentially negative. A Mazzini test of the mother's blood was negative. Blood, urine, and spinal fluid findings were normal. Encephalograms made on April 28 revealed a communicating cyst of the cavum vergae, and a non-communicating cyst of the cavum septi pellucidi (Fig. 8).

The convulsions decreased in frequency, and the child was discharged on May 6, 1944, with a maintenance dose of 1/2 gr. phenobarbital t.i.d. When seen on July 25, 1944, in the outpatient clinic, he had had no convulsions, was eating well and gaining weight, and objectively there were no abnormalities.

Comment: There was no definite explanation for the admission complaints in this case. Convulsive seizures are not uncommon, however, in the presence of these anomalies. These complaints have been reported as improving or disappearing following encephalography.

CASE 6: D. J. A., a white female infant aged eight months, was admitted to the hospital on July 21, 1944, because of convulsions, emotional instability, and bowel and urinary incontinence of three weeks' duration.

Physical examination was essentially negative. Laboratory studies were non-informing. Encephalograms made on Aug. 17, 1944, revealed a moderate dilatation of the ventricular system. A communicating cyst of the cavum vergae was demonstrated. There was some coarsening of the subarachnoid pathways, suggesting the possibility of cerebral hypoplasia (Fig. 9).

The patient continued to have convulsions and was placed on a maintenance dose of phenobarbital with a reduction in the number of seizures. She was discharged on Aug. 18, 1944, to be followed in the outpatient clinic.

AGENESIS OF THE CORPUS CALLOSUM

As stated at the beginning of this paper, the other mid-line anomaly which we wish to discuss is agenesis of the corpus callosum.

Prior to the introduction of encephalography by Dandy in 1919, the diagnosis of agenesis of the corpus callosum was dependent upon its accidental discovery at autopsy, since a definite clinical syndrome has never been established. It was not until 1934, however, that this anomaly was recognized in a living patient by encephalography and was reported by Davidoff and Dyke (9). The first of three cases reported by these authors was interpreted as revealing a communicating cyst of the cavum septi pellucidi. It was only at autopsy, following a craniotomy, that complete agenesis of the corpus callosum was recognized. Guttmann (10) failed to recognize the characteristic changes in the encephalograms in one case which was later discovered at autopsy. Had he done so, his would have been the first case diag-



Fig. 9. Case 6: Communicating cyst of the cavum vergae (arrows). Dilatation of subarachnoid pathways. Note extension of the cavum vergae beneath the lateral ventricles (arrows) in the sagittal view.

posed during life. Hyndman and Penfield (11) reported 5 cases. The first of these was discovered at operation after a diagnosis of cyst of the cavum septi pellucidi had been made.

The corpus callosum develops between the third and fifth month of fetal life. Retzius (12) has shown it to be an outgrowth of the lamina terminalis. Any arrested development of the corpus callosum is usually associated with faulty development of contiguous structures. Apparently the extent of the abnormality depends upon the time of embryonic arrest. Abnormalities may vary from a small defect in the splenium to complete absence of the corpus callosum, septum pellucidum, lyra of the fornices, and anterior commissure.

Bruce (13) has named the following subdivisions that may be used to determine the stage in the embryonic process at which arrested development has occurred:

First three weeks: Complete absence of the corpus callosum, when hemispheres

and ventricular system are a single undivided unit.

Fourth through the twelfth week: Absence of the corpus callosum and anterior commissure, but perfect division of the cerebral hemispheres by the longitudinal fissure.

During the fourth month: Presence of the anterior commissure and genu of the corpus callosum.

Lesser degrees of agenesis of the corpus callosum vary directly in proportion to the lateness of onset of arrested development.

Before the formation of the corpus callosum, radially arranged, shallow sulci are often visible on the mesial aspects of the embryonic cerebral hemispheres. Retzius and other workers believe these sulci to be transitory structures. Davidoff and Dyke suggested that the radially arranged convolutions and sulci on the medial aspects of the brain in cases of agenesis of the corpus callosum represent an anomalous preservation of those structures occurring prior to the third month of fetal life, before the corpus callosum is formed. They

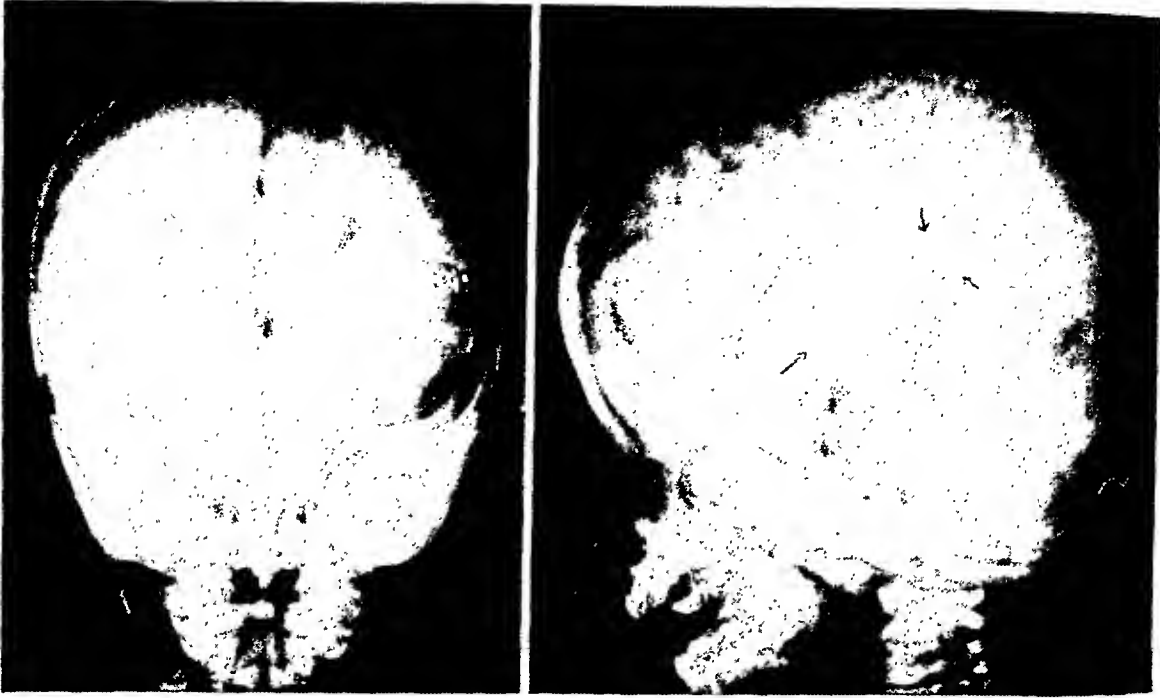


Fig. 10. Case 1: Complete agenesis of the corpus callosum. Separation of the lateral ventricles, pointing to their dorsal margins, concavity of their medial borders, and marked dilatation and elevation of the third ventricle in the sagittal view. A dilated interventricular foramen (single arrow) and radially arranged sulci (double arrows) extending through the zone of the corpus callosum, are seen in the lateral view.

base their opinion upon the fact that the preservation of these sulci in cases of complete agenesis can be demonstrated in the living, while in partial agenesis these radiations are found to be absent only dorsal to the partially formed corpus callosum and are seen to be retained where the latter structure has failed to develop.

Davidoff and Dyke concisely enumerate the characteristic encephalographic changes that are evidence of agenesis of the corpus callosum. They are: (1) marked separation of the lateral ventricles; (2) the angular dorsal margins of the lateral ventricles; (3) the concave mesial borders of the lateral ventricles; (4) the dilatation of the caudal portions of the lateral ventricles; (5) elongation of the interventricular foramina; (6) dorsal extension and dilatation of the third ventricle; (7) radial arrangement of the mesial cerebral sulci around the roof of the third ventricle and extension of these sulci through the zone usually occupied by the corpus callosum.

Bunts and Chaffee (14) state that no other cerebral lesion may be confused with this anomaly except possibly a com-

municating cyst of the cavum septi pellucidi.

Various other congenital defects such as porencephaly, microcephaly, and fetal configuration of the cortex of the brain and defects not related to the central nervous system may also exist in association with agenesis of the corpus callosum. Complete absence of this structure has been found in about one-half the cases reported.

Feeble-mindedness and convulsive seizures are the most common symptoms in agenesis of the corpus callosum. Less common are spastic paraplegia, athetoid movements, strabismus, and nystagmoid movements of the eyes. None of these is pathognomonic of the anomaly.

Case Reports

CASE 1: J. H. R., a seven-month-old white male infant, was admitted to the hospital on June 13, 1942, because of constipation, failure to gain weight, and feeding problem. All symptoms had been present since birth. Delivery had been normal. The patient could not sit at the time of admission. The family history was negative.

The child was markedly undernourished, pale, and somewhat dehydrated. The other positive physical

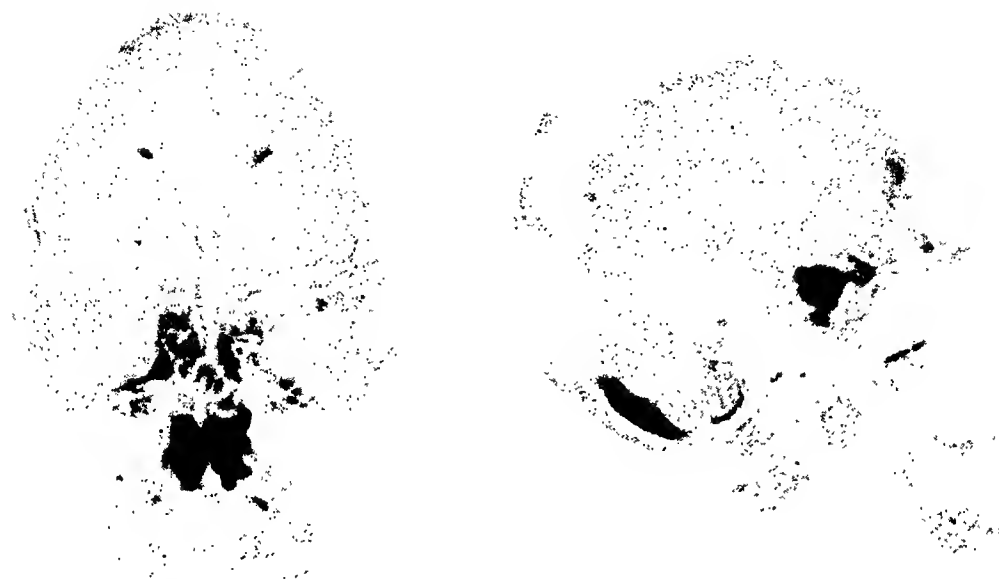


Fig. 11. Case 2: Partial agenesis of the corpus callosum. Separation of lateral ventricles, pointing of their dorsal margins, and elevation of the third ventricle all noted in the sagittal view. Findings inconclusive in lateral view.

Findings were cervical lymphadenopathy and moderate abdominal distention. All laboratory examinations of the blood cells, serology, urine, and spinal fluid were normal.

X-ray examination of the cervical spine showed spina bifida occulta of each segment. With the aid of a barium enema a moderate megacolon was demonstrable. Encephalograms made on Aug. 5, 1942, revealed a dilatation of the lateral and third ventricles and the interventricular foramina. The lateral ventricles were separated, their dorsal margins were angular, and their medial walls were slightly concave. The third ventricle was markedly displaced dorsally between the lateral ventricles. The callosal sulcus was not visualized, and there was evidence of radially arranged mesial cerebral sulci around the roof of the third ventricle and extending through the zone of the corpus callosum (Fig. 10).

The child gained weight during his hospital stay, which was uneventful. He was discharged to the outpatient clinic on Aug. 15, 1942. He was re-hospitalized from March 8 to March 16, 1943, for further study because of repeated convulsive seizures.

Comment: We believe that this case represents the findings of complete agenesis of the corpus callosum. It is the only case in our series with other demonstrable developmental anomalies.

CASE 2: J. L. D., a 14-year-old boy, was admitted on Nov. 18, 1942, because of convulsions, loss of memory, and paralysis of the left side, of three

months' duration. Physical examination showed him to be a fairly well developed and well nourished patient. There was a loss of strength in the left hand; otherwise, the examination was non-informing. All laboratory studies were essentially normal.

Encephalograms made on Nov. 25, 1942, were not entirely satisfactory due to incomplete filling of the ventricular system. There was evidence of separation of the lateral ventricles and some elevation of the third ventricle was noted. No dilatation of the ventricular system was evident. It was suggested that a partial agenesis of the corpus callosum existed. Repeat studies were requested in the hope of more completely filling the ventricular system. These (Dec. 8, 1942) revealed essentially the same findings as those in the initial examination (Fig. 11).

Comment: We believe this case presents the encephalographic findings of partial agenesis of the corpus callosum.

DISCUSSION

A review of the literature on congenital cysts of the septum pellucidum reveals reports of 15 cases that have been diagnosed by encephalography or ventriculography. Our own bring the total to 21. These are listed as to type, and the order of their appearance in the literature, in Table I.

The age incidence for this group varied from six weeks to fifty-two years. Eleven

TABLE I: REPORTED CASES OF CONGENITAL CYSTS OF THE SEPTUM PELLUCIDUM DIAGNOSED BY ENCEPHALOGRAPHY OR VENTRICULOGRAPHY

Author	Cavum Septi Pellucidi		Cavum Vergae		Complete (Both)	
	Communi- cating	Non- communi- cating	Communi- cating	Non- communi- cating	Communi- cating	Non- communi- cating
Meyer (6)	1	..	..	..	..	..
Dandy (1)	..	..	..	..	..	2
Van Wagenen and Aird (5)	3	1	1	..	..	..
Pendergrass and Hodes (8)	3	..	..	..	1	..
Tönnis (17)	..	1	..	..	..	..
Berkwitz (15)	..	1	..	..	..	..
Leslie (16)	..	..	..	1	..	..
Echternacht and Campbell	1	2	2*	..	..	1
TOTAL...21	8	5	3	1	1	3

* One of these (Case 5) was associated with a non-communicating cyst of the cavum septi pellucidi.

cases said to occur in males were found in the available literature. Only 2 are known to have occurred in females. In our own series there were 3 males and 3 females.

No definite statement can be made regarding the incidence of these cysts in normal persons as compared with the mentally deranged. There is no reason to believe that the neurological abnormalities shown in these cases are dependent upon the presence of the cavities.

Only 18 cases of agenesis of the corpus callosum diagnosed by encephalography or ventriculography are reported. Our 2

cases make a total of 20. These cases are listed in the order of their appearance in the literature, and as to classification in Table II.

The age range in reported cases is from six months to twenty-nine years. The age range in autopsy material is reported to be from birth to seventy-three years. There is no evidence of sex being a determining factor. Of the 17 patients for whom the sex is given, 9 were males and 8 females. Both of our patients were males.

CONCLUSIONS

1. Congenital cysts of the cavum septi pellucidi and cavum vergae of the non-communicating and communicating type, and agenesis of the corpus callosum, either complete or partial, cannot be diagnosed during life except by encephalography or ventriculography.

2. These mid-line anomalies of the brain should be considered as possible causes of obscure cases of epilepsy, abnormal mentality, and other neurological conditions.

3. When communicating cysts of the septum pellucidum are discovered in sagittal projections and are not clearly defined in lateral views, the cavum vergae may be differentiated from the cavum septi pellucidi by the way in which it flares out at its base beneath the lateral ventricles.

4. Six cases of congenital cysts of the

TABLE II: REPORTED CASES OF AGENESIS OF THE CORPUS CALLOSUM DIAGNOSED BY ENCEPHALOGRAPHY OR VENTRICULOGRAPHY

Author	Complete	Partial	Not Determined
Guttmann (10)	..	..	1
Davidoff and Dyke (9)	1	1	1
Hyndman and Pen- field (11)	2	3	..
Foerster (24)	1	..	..
Köttgen (23)	1	..	..
Cass and Reeves (18)	..	..	1
Reeves (21)	..	..	1
Kunicki and Chorob- ski (19)	1	..	..
Gowan and Masten (22)	..	..	1
Goldenson <i>et al.</i> (20)	..	1	..
Derbyshire and Evans (25)	..	1	..
Bunts and Chaffee (14)	1	..	..
Echternacht and Campbell	1	1	..
TOTAL.....20	8	7	5

MID-LINE ANOMALIES OF THE BRAIN

131

septum pellucidum and 2 cases of agenesis of the corpus callosum are reported, with a review of the literature on these anomalies.

NOTE: Since the presentation of this paper, the authors have seen 2 additional cases of communicating cysts of the cavum vergae and 1 non-communicating cyst of the cavum septi pellucidi.

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Lesions of the Aqueduct of Sylvius¹

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THE FIRST CASE of congenital occlusion of the aqueduct of Sylvius was reported by Hilton in 1847. Pancoast, Pendergrass, and Schaeffer have stated in their classic work, "The Head and Neck in Roentgen Diagnosis," that of all of the lesions revealed by ventriculography those obstructing the aqueduct are the most difficult to diagnose. Twining emphasized the danger of being misled by inadequate visualization of the aqueduct and fourth ventricle and discussed the hydrodynamics involved in filling these structures with air.

Complete replacement of cerebrospinal fluid with air is seldom possible by ventricular puncture in the presence of a blocked ventricular system. The difficulties encountered, therefore, are largely technical and involve positional manipulation of the available air to establish the point of occlusion of the system. However, there are also the possibilities of an incomplete block of the aqueduct and unsatisfactory visualization of an air-filled aqueduct due to superimposed structures that obscure it. The roentgenologist is so often called upon for aid in establishing the preoperative diagnosis by air studies of the ventricular system that it seems justifiable to discuss the difficulties encountered in this procedure.

The roentgen diagnosis is dependent upon failure to visualize the aqueduct, together with the positive findings of obstructive hydrocephalus, namely: (1) symmetrical dilatation of the lateral ventricles; (2) dilatation of the foramina of Monro; (3) dilatation of the third ventricle; (4) dilatation of the aqueduct rostral to the point of obstruction. These criteria may be established by conventional positioning

in most cases in which an adequate replacement of fluid by air is effected by the neurosurgeon. In some cases, however, the superimposed bony structures of the cranium or air in dilated lateral ventricles may obscure the region of the aqueduct, necessitating the use of body-section roentgenography. Mid-line lateral laminagrams will give clear visualization of the aqueduct and third and fourth ventricles in such cases. In all instances of failure to visualize the aqueduct or fourth ventricle by conventional roentgenography, we resort to laminagraphic sections in both lateral and frontal projections.

The use of heavy opaque media to demonstrate the point of obstruction, as recommended by Olivecrona, Lysholm, Freeman, and others, is not without risk and has not been regarded favorably by our neurosurgical colleagues. Ventricular injection of lipiodol has been used only once in our clinic for corroboration of the point of occlusion of the aqueduct of Sylvius.

Definite localization of the site of obstruction in obstructive hydrocephalus is of paramount importance. A surgical decision to explore the lesion above or below the tentorium may rest largely upon the ventriculographic findings. An erroneous diagnosis, leading to ill-advised suboccipital decompression and exploration of the posterior fossa, may prove disastrous in a patient with a high aqueductal occlusion. Similarly, a supratentorial exploration will accomplish little for the patient with a subtentorial posterior fossa lesion. A negative exploratory procedure in either case may seriously jeopardize the chance for survival.

In a review of our ventriculographic studies in cases of obstructive hydrocephalus

¹ From the Department of Radiology, Yale University School of Medicine. Presented at the Joint Meeting of the American Roentgen Ray Society and the Radiological Society of North America, Chicago, Ill., Sept. 21-23, 1944.

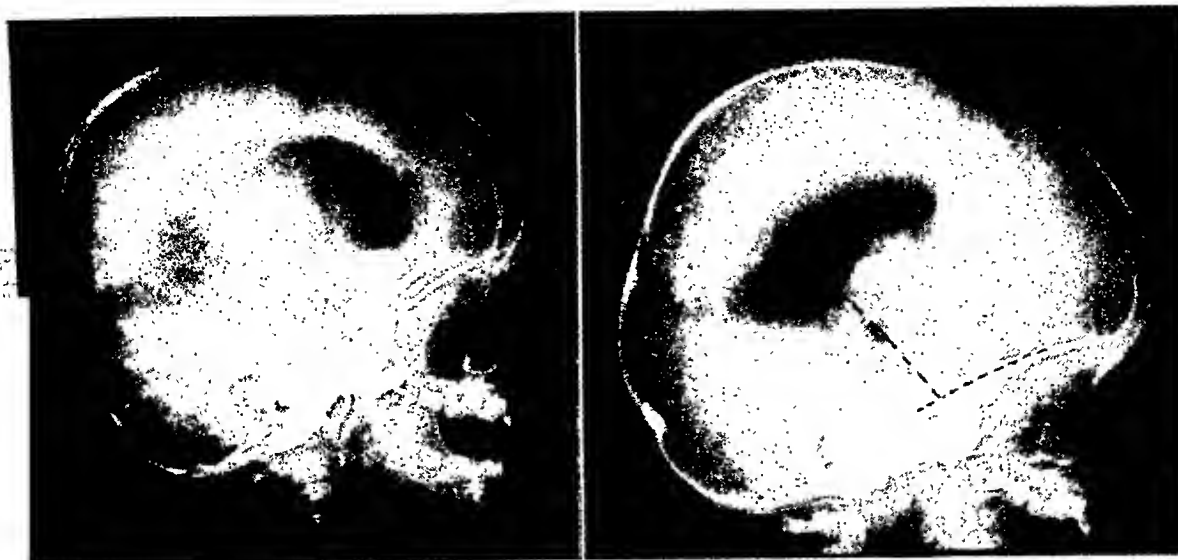


fig. 1. Infratentorial obstruction of aqueduct by posterior fossa tumor; verified medulloblastoma. Note decreased angle (110°) as compared with the angle in Figure 2.

lus, it was noted by one of us (W. G. L.) that a rotation of the third ventricle on its horizontal axis occurred in a number of instances of subtentorial tumor. In order to evaluate the significance of this finding, we restudied a group of cases of obstructive hydrocephalus. A line was drawn

TABLE I: OBSTRUCTION OF AQUEDUCT

Site	Age	Lesion	Angle
Supratentorial			
Case 1	13	Pinealoma	140°
Case 2	11	Pinealoma	135°
Case 3	16	Stenosis	150°
Case 4	19	Stenosis	155°
Case 5	8	Stenosis	150°
Infratentorial			
Case 6	18	Astrocytoma	128°
Case 7	21	Astrocytoma	135°
Case 8	2	Astrocytoma	130°
Case 9	1	Medulloblastoma	110°
Case 10	3	Ependymoma	120°
Case 11	63	Hemangioma	140°
Case 12	16	Spongiblastoma polare	135°
Supratentorial and Infratentorial			
Case 13	51	Metastatic melanoma	140°
Case 14	53	Reticulum-cell sarcoma	133°
Average, Supratentorial Lesions			144°
Average, Infratentorial Lesions			128°
Average, Non-neoplastic Stenosis			152°

along the base of the anterior fossa, *i.e.*, along the lesser wings of the sphenoid. A second line was drawn from the anterior clinoid process to the suprapineal recess.

The measured angle included between these lines was noted in two groups of cases, of proved supratentorial and infratentorial tumors, respectively, and in a control group of normal pneumoencephalograms. It was found that the angle was usually 140° degrees in normal air studies; it was significantly decreased in cases of infratentorial tumors, and was usually increased in non-neoplastic obstruction of the aqueduct above the tentorium. Table I lists the angle measurements in a series of verified lesions producing obstruction of the aqueduct.

The usual classification of lesions resulting in occlusion of the aqueduct is (a) neoplastic, (b) non-neoplastic. The neoplastic lesions may be further subdivided depending upon their origin above or below the tentorium. Occasional instances of multiple tumors will be encountered, with both supratentorial and infratentorial foci.

The material for this study consists of 14 verified lesions in which a roentgen diagnosis of aqueduct stenosis was made. Eleven cases of neoplastic stenosis and 3 of non-neoplastic stenosis were encountered. Seven infratentorial tumors and 2 supratentorial tumors produced obstruction of the aqueduct. Two examples of multiple neoplastic lesions were encoun-

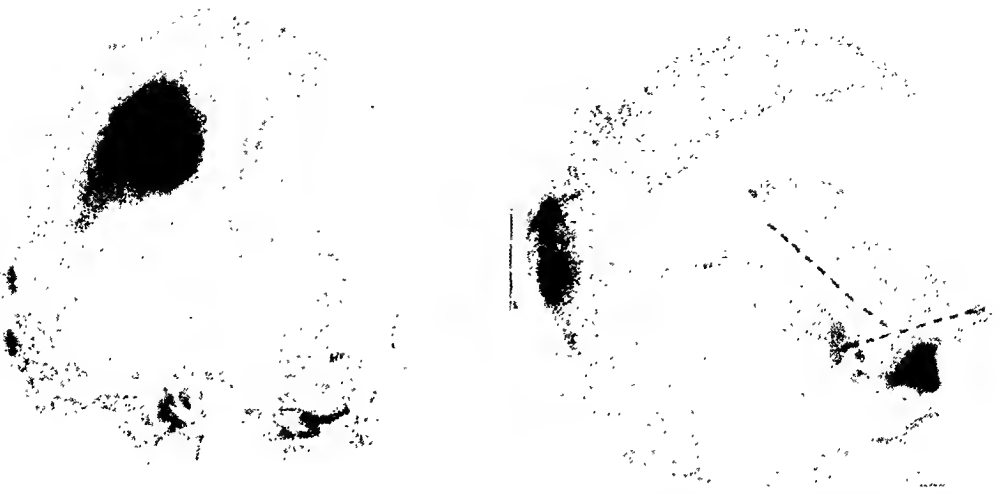


Fig. 2. Supratentorial obstruction of aqueduct and defect of posterior portion of third ventricle due to a pinealoma. Angle of 135° is slightly decreased as a result of the intraluminal defect.

tered, with foci of tumor both above and below the tentorium.

The group of 7 infratentorial neoplastic lesions includes (a) 3 astrocytomas, (b) a medulloblastoma (Fig. 1), (c) an ependymoma, (d) an hemangioma, (e) a spongionblastoma polare. The clinical findings in all except one of these cases suggested a lesion of the posterior fossa. The ventriculographic studies showed characteristic signs of obstructive hydrocephalus. Two cases of supratentorial lesions were verified pinealomas. The ventriculographic findings are illustrated in Figure 2.

One of the two cases of multiple tumors was verified at autopsy as a reticulum-cell sarcoma involving the cerebrum, cerebellum, and liver. The second case (Fig. 3) was one of malignant melanoma with metastases in both lateral ventricles, third ventricle, aqueduct, and periventricular region of the fourth ventricle. None of the neoplastic lesions in this series is a primary tumor of periaqueductal tissue. Globus, Kuhlenbeck, and Weller state that "true blastomatous lesions arising from cellular elements of the walls of the aqueduct are rare." Four such cases occurred in a series of 250 primary neuro-ectodermal neoplasms. Two of these were hemangiomas, one a pinealoma, and only one a

definite neuroglioma that could be traced to the peri-aqueductal tissue.

In our series the occlusion of the aqueduct was proved non-neoplastic in character in 3 cases. Figure 4 illustrates the ventriculographic findings. The presence of a wide angle between the suprapineal recess and the plane of the lesser sphenoid wings was the most helpful criterion observed in the cases of non-neoplastic stenosis of the aqueduct, contrasting well with the normal or decreased angle measured in cases of aqueduct occlusion secondary to posterior fossa tumors. Further observations are necessary to establish the validity of this criterion in differential diagnosis. In contrast to pinealomas which usually obliterate the suprapineal recess and produce a filling defect in the posterior wall of the third ventricle, simple aqueduct stenosis results in ballooning out of the recess and occasionally in posterior herniation of the third ventricle. It should be mentioned that angle measurements cannot be accurately made and would be unreliable when the suprapineal recess is obliterated. The nature of the aqueductal occlusion, if the patent portion of the aqueduct is visualized, may also give valuable differential aid, inasmuch as non-neoplastic stenosis usually produces a tapering de-

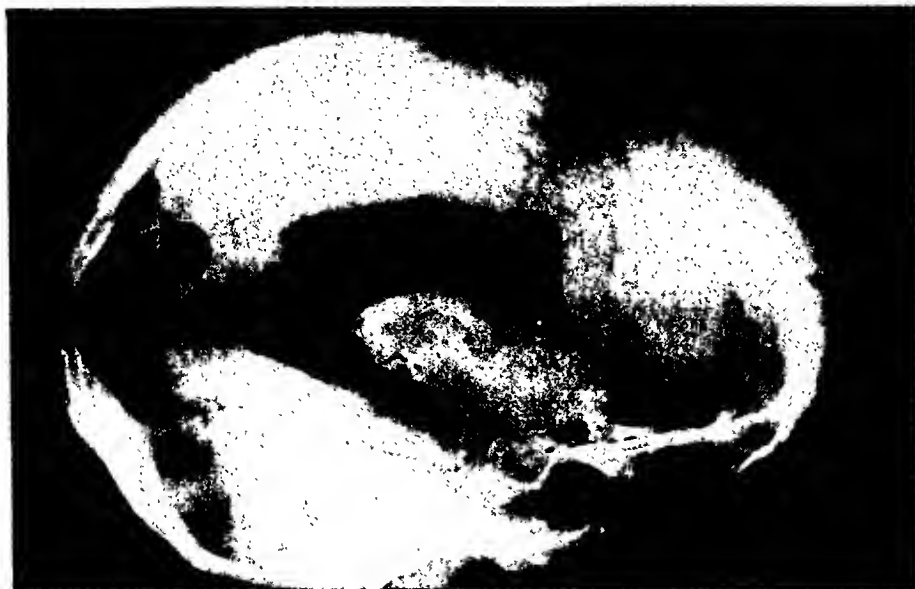


Fig. 3. Supratentorial obstruction of aqueduct by metastatic melanoma. Tumor was found in the third ventricle as well as below the tentorium in the fourth ventricle. Angle 140° .

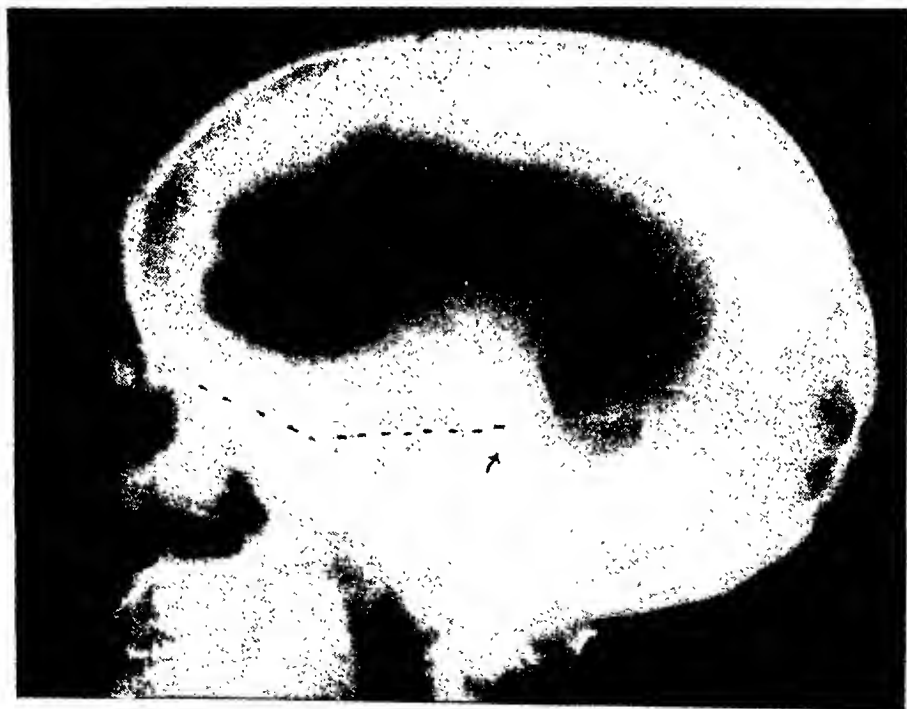


Fig. 4. Supratentorial obstruction of aqueduct by non-neoplastic stenosis. Note wide angle (148°) and diverticulum of third ventricle above and posterior to narrowed iter.

crease in caliber over a rather long segment of the aqueduct, whereas an abrupt occlusion, with dilatation of the rostral end is more characteristically observed in stenosis due to tumors. This is probably the least reliable of the diagnostic features.

The pathological changes in non-neoplastic stenosis are the result of proliferation of normal subependymal glial tissue around the aqueduct. Stookey and Scarff described these changes in 12 of their 16 reported cases.

According to Pennybacker, the subependymal glial cells, and especially their fibrillar elements, seem to proliferate and cause a true stricture of the aqueduct from without, or the proliferation may break through the ependyma to form tufts within the lumen, forming valve-like membranes. The lumen may be split up into a number of tiny channels, invisible to the naked eye, and may then be compared to a swamp, through which cerebrospinal fluid seeps with considerable difficulty.

Two theories have been offered to explain the findings in non-neoplastic stenosis of the aqueduct: (a) developmental anomaly and (b) intra-uterine infection resulting in secondary proliferation of subependymal glia. Dandy believes the fetal ependyma may be injured by intra-uterine toxic, traumatic, or inflammatory processes with subsequent glial proliferation leading to stenosis. Spiller supports the theory of a developmental anomaly and draws an analogy between the stenosis of the aqueduct and progressive narrowing of the central canal of the spinal cord. He believes the aqueduct may undergo partial or complete closure by early developmental error. He found closure of the central canal of the cord occurring between the ninth and seventeenth years.

Parker and Kernohan have described a group of patients, ages 16, 17, and 19 years, respectively, in whom no hint of the origin of the stenosis was evident. There were no associated developmental anomalies and no history of any preceding inflammatory process. These authors be-

lieved that it was necessary to assume that the changes in the aqueduct were due to a process in adult life or to a process developing in an already partially stenosed aqueduct, leading to complete occlusion.

In search for a more satisfactory explanation, we are impressed by the work of Zimmerman *et al.* on lesions of the central nervous system produced by vitamin B deficiency. Zimmerman found changes identical with hemorrhagic pseudo-encephalitis of Wernicke in the brains of persons who died with vitamin B deficiency. He found that this condition had a particular predilection for certain sites in the brain, such as the paraventricular gray matter of the third ventricle, the mammillary bodies, the peri-aqueductal region, the corpora quadrigemina, and the region beneath the ependymal lining of the floor of the fourth ventricle. He was able to prove experimentally, on the pigeon, dog, and fox, that Wernicke's pseudo-encephalitis was definitely associated with chronic vitamin deficiency. The distribution of the lesions in the experimental animal parallel those found in man. The microscopic changes following subsidence of the acute hemorrhagic phase of the disease are those of gliosis and associated increased vascularity. These changes are suggestive of those found in non-neoplastic occlusion of the cerebral aqueduct.

The recent suggestion by Hartley and Burnett that the changes observed in the case of craniolacunia associated with hydrocephalus may be due to deficiency of a factor during early pregnancy, resulting in defective development of portions of the fetal cranium, is interesting. These authors do not describe the autopsy findings in the brain. One would like to know whether the hydrocephalus was due to occlusion of the aqueduct.

In a personal communication, Dr. H. N. Greene has described his observations of hydrocephalus affecting approximately 10 per cent of the young rabbits in his rabbit colony. One type of hydrocephalus in certain strains is observed at two weeks of age and leads to a high mortality. A study

f the hereditary factors has shown considerable variation in genetic proportion of involvement in the progeny contrary to Mendelian law. During the study, the progeny of rabbits receiving added vitamins in their food during pregnancy showed a marked decrease in incidence of hydrocephalus. Conversely, when the pregnant rabbits received food of inferior quality, without added vitamins, there was notable increase in hydrocephalus in the progeny, amounting to almost 100 per cent. Vitamin A replacement in part of the colony, without other change in formula, reduced the incidence to the normal regular figure. Although sections of the brains of these animals have so far failed to demonstrate obstruction of the ventricular system or evidence of gliosis, it would seem that a restudy of the problem might be indicated in the light of the deficiency changes observed in human and animal glial tissue by Zimmerman.

c In a recent case of craniolacunia associated with meningocele and hydrocephalus, the history of the patient's mother was of special interest. During her first pregnancy, at twenty years of age, the mother was seriously ill with pernicious vomiting of pregnancy throughout the period of gestation. In the child of this pregnancy a spina bifida was noted at birth, and a progressive hydrocephalus developed, with death at fifteen months of age. The second, third, and fourth pregnancies were uneventful except for moderate nausea and vomiting during the first three months, and they terminated in deliveries of normal living children. The fifth pregnancy was characterized by pernicious vomiting throughout the period of gestation and terminated in delivery of a living child. This infant was found to have a lumbar meningocele and craniolacunia, and progressive hydrocephalus developed. Ventriculographic and pneumoencephalographic studies demonstrated symmetrical dilatation of the lateral ventricles and dilatation of the third ventricle. The aqueduct and fourth ventricle were not filled on repeated attempts following both

ventricular and subarachnoid replacement of fluid with air. The evidence strongly favored obstruction of the aqueduct and foramina of Luschka and Magendie. The patient's head circumference increased from 34 to 47 cm. in five and one-half months.

The present concepts of non-neoplastic aqueductal stenosis based upon (a) developmental anomaly and (b) intra-uterine inflammatory lesion healing by gliosis may be correlated. An experimentally induced vitamin deficiency state has been shown to result in localized changes in the periaqueductal tissue. The observed findings in aqueduct stenosis suggest that they might result from a nutritional deficiency developing either during intra-uterine life or later. This hypothesis may also explain the variable age at which such lesions produce symptoms. Until such a relationship can be proved, we will have to retain both of the present theories of pathogenesis.

SUMMARY

1. The difficulties in roentgen demonstration of occlusion of the aqueduct are reviewed.

2. The differential roentgen diagnosis of supratentorial and infratentorial lesions is discussed and a new roentgen sign is described.

3. Eleven cases of neoplastic stenosis and three cases of non-neoplastic stenosis are reported.

4. The theories of pathogenesis of non-neoplastic stenosis of the aqueduct are reviewed. The role of a nutritional deficiency as an etiological factor is discussed in the light of recent experimental evidence.

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Observations on the Presence of Subdural Gas After Pneumoencephalography¹

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THE PRESENT study was undertaken to investigate the significance and mechanism of filling of the subdural space with gas following pneumoencephalography. Several articles concerning this subject have appeared in the literature and are well reviewed by Von Storch and Buermann (6). No systematic study of roentgenograms made twenty-four hours after encephalography has appeared, however, except for a reference by Penfield and Norcross (8). They found that 18 of 22 patients with post-traumatic headaches, on whom second day roentgenograms were obtained following spinal insufflation, showed gas in the subdural space, while only 2 of 18 controls showed subdural gas. These findings suggested that the demonstration of subdural gas on twenty-four hour roentgenograms was almost pathognomonic of post-traumatic headache. It should be pointed out, however, that the technique employed in the two groups differed. Our experience with subdural gas was at variance with this conclusion and we felt it necessary to make more extended observations, particularly since we could find no other information in the literature except for a report of 4 cases by Von Storch and Buermann and 2 by Pendergrass and Hodges (7).

METHOD

For the purposes of this study a series of 78 consecutive pneumoencephalograms was reviewed. No selection of cases was made, the only requirement being that each patient have had upright frontal and lateral roentgenograms made immediately after the introduction of the gas and similar roentgenograms twenty-four hours later.

These were studied with reference to ventricular size (lateral ventricles), degree of filling of the subarachnoid spaces, the presence or absence of cerebral atrophy or other recognizable abnormality, and the presence or absence of gas in the subdural space, either under the tentorium or over the convexity of the brain. The present report will deal largely with this latter aspect, *i.e.*, the presence of subdural gas and its possible diagnostic significance.

In addition to objective comparison of the size of the lateral ventricles in the two sets of films, a simple measurement was employed which was found useful in comparing the variations that occurred. This consisted in measuring the diagonal distance through portion three (9) (the central part of the body of the ventricle), as seen in the frontal projection, from the junction of the roof of the ventricle and the septum pellucidum to the height of the convexity of the lateral wall. This measurement was selected since it usually could be made even when the ventricular drainage had been incomplete and it gave a fairly satisfactory index of the degree of ventricular collapse, when such occurred.

The amount of subdural gas, if present, was graded on the basis of 1 to 4. This included both subtentorial and convexity gas, since it can be demonstrated that, normally, free communication exists between all parts of the subdural space, and gas that may be seen under the tentorium in one projection can, with posture, be shifted to various parts of the space.

About half of the encephalograms were obtained by the single puncture and syringe method; for the others, the two-needle method, using a closed system, was

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TABLE I: PRESENCE OR ABSENCE OF SUBDURAL GAS IN IMMEDIATE AND TWENTY-FOUR-HOUR ROENTGENOGRAMS

Disease Category	Cases	Immediate Films		Twenty-Four-Hour Film	
		No Subdural Gas Cases	Subdural Gas Cases	No Subdural Gas Cases	Subdural Gas Cases
Post-traumatic	14 (18%)	8 (29%)	6 (12%)	3 (13%)	11 (78%)
Tumor or suspected tumor	8 (10%)	2 (7%)	6 (12%)	2 (8%)	6 (11)
Cryptogenic epilepsy	20 (26%)	4 (14%)	16 (32%)	6 (25%)	14 (28)
Psychosis or psychoneurosis	3 (4%)	1 (4%)	2 (4%)	1 (4%)	2 (4)
Other organic disease of central nervous system or diagnosis deferred	24 (31%)	9 (32%)	15 (30%)	8 (33%)	16 (66)
Congenital lesions	9 (12%)	4 (14%)	5 (10%)	4 (17%)	5 (9)
TOTAL	78 (100%)	28 (100%)	50 (100%)	24 (100%)	54 (100)

employed. Air was the contrast medium in all cases.

RESULTS

The immediate and the twenty-four-hour roentgenograms have been studied in a total of 78 cases. Considering first the immediate encephalograms, it was found that 28, or 36 per cent, showed no recognizable subdural gas accumulation, while the remainder (50 cases, or 64 per cent) showed subdural gas either under the tentorium or over the convexity of the hemispheres, or in both locations. An analysis of such subdural filling as seen in various disease states is given in Table I. Subdural filling was encountered in all of the common categories of disease of the central nervous system, and its incidence in these various conditions corresponds closely to the incidence of the disease in the entire series.

An analysis of the presence or absence of subdural gas in the twenty-four-hour roentgenograms, also, is given in Table I. Twenty-four of the 78 cases showed no subdural gas on the second day while 54 showed various degrees of subdural filling. Here again the percentage distribution of subdural filling in the various diseases corresponds closely to their incidence. It seemed apparent at this stage of the study that the mere presence of subdural gas, as shown on the first- or second-day roentgenogram alone, was of no diagnostic significance. Regardless of the clinical diagnosis, it occurred in approximately 64 per cent of the cases immediately after

the insufflation of the gas, and in 60 per cent it could be demonstrated at twenty-four-hour period. Further study of the details of filling of the subdural space then was carried out.

In Table II a comparison is made of character of subdural gas accumulation both the immediate and the twenty-four-hour examination. The cases have been classified according to the type of subdural filling, and the incidence of the various diseases for each type of filling is given. Five types of subdural filling could be distinguished. The first type was represented by a group of 16 cases in which there was no subdural gas either at the immediate examination or after twenty-four hours. In a second group, there was subdural gas at the immediate examination but variable amounts were present at the second-day examination. There were 14 cases in this group. In the third group of 24 cases, subdural gas was present at the immediate examination and also at twenty-four hours but had increased in amount during the intervening period. The fourth group, of 8 cases, showed the presence of subdural gas on both days without change in the amount. In the fifth group of 16 cases, the immediate examination showed subdural gas but this had decreased in amount or had entirely disappeared at the second-day examination. There were 18 cases in this group.

In 48 cases (60 per cent) subdural gas was present on the first day, but only 8 of these was there any gas left under the tentorium on the second-day roent-

TABLE II: TYPES OF SUBDURAL FILLING IN VARIOUS DISEASE CATEGORIES

Disease Category	No. of Cases	Cases with No Subdural Gas Either Day	Cases with Subdural Gas Both Days; No Change in Amount	Cases with Subdural Gas Both Days; Increased Second Day	Cases with Subdural Gas First Day; Decreased or Absent Second Day	Cases with No Subdural Gas First Day; Subdural Gas Second Day
Post-traumatic	14 (18%)	3 (19%)	0	5 (21%)	1 (6%)	5 (42%)
Tumors or tumor suspects	8 (10%)	2 (12%)	2 (25%)	2 (8%)	2 (11%)	0
Cryptogenic epilepsy	20 (26%)	2 (12%)	3 (38%)	6 (25%)	7 (38%)	2 (17%)
Psychosis or psychoneurosis	3 (4%)	0	1 (12%)	0	1 (6%)	1 (8%)
Other organic disease of central nervous system or diagnosis deferred	24 (31%)	6 (38%)	2 (25%)	8 (33%)	5 (27%)	3 (25%)
Congenital lesions	9 (12%)	3 (19%)	0	3 (13%)	2 (11%)	1 (8%)
TOTAL	78 (100%)	16 (100%)	8 (100%)	24 (100%)	18 (100%)	12 (100%)
Prevalence of type of subdural filling in series		21%	10%	31%	23%	15%

roentgenograms and then it was in most instances only a trace. In but one case was the subtentorial gas increased on the second day, while in all the others it was greatly decreased. Subdural gas was never seen under the tentorium on the second-day roentgenograms unless it had been demonstrable on the immediate films. These facts strongly suggest that subtentorial gas is always the result of the introduction of gas into the spinal subdural space. A similar conclusion was reached by Von Borch and Buermann in regard to subdural gas under the basal cisterna. Since there is free communication between all portions of the subdural space above and below the tentorium, there would always remain the possibility that convexity air was of the same origin when gas had previously been present under the tentorium. In only 12 cases (15.4 per cent) was there any evidence of gas in the subdural space over the convexity of the hemispheres on the immediate roentgenogram, and among these cases there was subtentorial filling in 10. There is a strong suspicion that under these circumstances it was of spinal origin. On the second-day roentgenograms subdural gas over the convexity was present in 54 cases (69 per cent). In only 12 of this latter group was gas present in the subdural spaces over the convexity of the brain when there had been none either there or under the tentorium on the first day. This constitutes one group in which

TABLE III: CASES SHOWING AN INCREASE OF SUBDURAL FILLING ON THE TWENTY-FOUR-HOUR ROENTGENOGRAM

Disease Category	Cases	Increased Subdural Gas* on Twenty-Four-Hour Examination		
		Cases	Per Cent †	Per Cent of Total Cases of Disease
Post-traumatic	14 (18%)	10	28%	71%
Tumors or suspected tumors	8 (10%)	2	5%	25%
Cryptogenic epilepsy	20 (26%)	8	22%	40%
Psychosis or psychoneurosis	3 (4%)	1	3%	33%
Other organic disease of central nervous system, or diagnosis deferred	24 (31%)	11	31%	46%
Congenital lesions	9 (12%)	4	11%	44%
TOTAL	78 (100%)	36	100%	

* Thirty-six (40%) of the cases showed this type of subdural filling.
† All percentages figured to nearest whole number.

there could be reasonable certainty that the gas had not arisen as a result of direct introduction into the spinal subdural space. The diagnosis in 5 of these cases was a post-traumatic condition and in the others was as follows: psychoneurosis, Alzheimer's disease, cryptogenic epilepsy, epilepsy with arteriosclerosis, cortical atrophy of undetermined origin, hypertensive encephalomalacia, and multiple congenital anomalies of the brain. In the group of cases showing an increase of subdural filling on the second day over that present on the first day, we may

in those cases which show no subdural filling on either day. This is illustrated by the fact that the measurements of the ventricles decreased on an average of 5 mm. in the first group and decreased an average of less than 1 mm. in the latter group. Nevertheless, there were some instances where a well defined collapse of the ventricles occurred without any convexity gas being present, suggesting that the ventricular collapse is not always due primarily to pressure from the accumulation of gas in the subdural space. Whether the change in ventricular size in these cases is due to fluid accumulation in the subdural or subarachnoid spaces or to increase in brain volume (edema or vascular dilatation) is not clear. The latter is suggested by the symmetry of the decrease when it does occur. In general, the findings would indicate that the subdural air on the second day is derived largely from that previously in the ventricles but do not necessarily imply that it passed directly from ventricles to subdural spaces; rather that it does not linger in the subarachnoid space long enough to be absorbed. This reciprocal relationship between ventricles and subdural filling suggests that gas passes from the ventricles to the subdural space, or rather that ventricular collapse may be one of the chief factors in producing tension on arachnoidal adhesions present over the vertex and so leading to a laceration of the arachnoid and entry of gas into the subdural space.

There were 9 patients who showed no change in the size of the ventricles, while 7 showed an increase in size as indicated by our measurements. Since all the physical factors in taking the films were identical on the two days, this finding could not be denied. Several possible explanations for such an increase in size of the ventricles exist. *First*, gas previously trapped in the cervical region, cisterna magna, the subarachnoid space of the posterior fossa, or even in the third and fourth ventricles, might pass upward into the lateral ventricles. This is clearly the cause in some cases. *Second*, the ventricles might dilate

due to the fact that no air leaves the while at the same time there is a rapid sorption of gas from the subarachnoid space without a commensurate filling of the space with recently formed cerebrospinal fluid. *Third*, there may in some instances be an abnormality in the gaseous interchange between the air in the ventricles and the tension of the gases in the cerebral tissues or blood vessels. *Fourth*, a difference in the intracranial pressure between the two days, and to a lesser extent of temperature, might alter the gas volume.

Many authors have noted the fact that gas introduced into the dilated ventricle of a patient with hydrocephalus may remain for many weeks, indicating that there is very little if any gaseous interchange through the tissues lining the ventricle in these patients, and the same no doubt may be true of the relatively normal ventricle.

Of the 7 cases that exhibited increase in size of the ventricles on the second day in films, 4 were post-traumatic (one with a 3-cm. skull defect; another with post-traumatic hydrocephaly). Of the remaining patients, 2 had cryptogenic epilepsy and 1 had Alzheimer's disease.

DISCUSSION

The significance of filling of the subdural space with gas following encephalography has not been entirely clear. For some authors it has been considered to be due primarily to an artefact of technique. Thus, Pendergrass (6) concluded that at lumbar puncture the point of the needle may come to be within the subdural rather than within the subarachnoid space. After a certain amount of fluid has been withdrawn, the arachnoid collapses and the air is injected directly into the subdural space from which it passes freely into the intracranial subdural space. A similar mechanism was assumed by Goette (3). There can be no doubt that such a mechanism is frequently operative in producing subdural filling. In our opinion, subtentorial gas is always of this origin, and the same conclusion has been previously reached.



Fig. 3. A. Immediate pneumoencephalogram, showing large subdural gas accumulations under the tentorium; some over the convexity of the cerebral hemispheres. B. Twenty-four-hour roentgenogram. There now are collections of subdural gas over the convexity, while that under the tentorium has disappeared. This may represent only a shift of the gas originally subtentorial, since the amount of gas seems about equal and the gas probably was introduced into the subdural space at the time of injection.

regard to filling of the basilar portion and the subdural space (Von Storch and Buermann).

The subdural space of the spinal canal differs from that of the cranium in the presence of numerous filamentous adhesions, which are especially numerous in the posterior aspect of the cervical region directly below the foramen magnum (Key and Metzius, 1875) (5). Hemmingson (4) suggested that rupture of the arachnoid membrane may occur at this point. We have seen no evidence as to the occurrence of this phenomenon. There is normally no communication between the subdural and subarachnoid space, so that gas which appears in the subdural space after the initial pneumoencephalograms must do so either by diffusion through the intact arachnoid or as a result of a tear or defect in the arachnoid. It has been demonstrated by Von Storch and Buermann that it is not possible to force air, oxygen, or carbon dioxide through an intact specimen of human arachnoid under pressures ranging from 150 to 450 mm. of physiologic salt solution maintained for twelve to one hundred and twenty-four hours. From their studies it was apparent that when a gas transfers

from the subarachnoid to the subdural space, it does so through a defect or tear in the arachnoid membrane. With removal of spinal fluid, the brain was thought to sink toward the base of the skull, producing tension on the arachnoid dural attachments such as are found normally in the region of the pacchionian granulations or elsewhere over the convexity in cases of post-traumatic headache. Our studies indicate that collapse of the ventricles may be a more important factor in producing these tears of the arachnoid which permit the escape of gas into the subdural space. The opposite, of course, may be true, *i.e.*, the ventricles may collapse because of the accumulation of gas over the hemispheres. However, in those cases where the subdural filling occurs on only one side in the twenty-four-hour examination, or where the amount of gas on one side is considerably larger than on the other, the decrease in size of the lateral ventricles does not always parallel the amount of subdural accumulation and may even be greater on the side with the least subdural gas. It is true that unilateral subdural filling at the immediate examination often is associated with depression, distortion, and narrowing

of the homolateral ventricle, but such deformity is less likely to occur in the second-day examinations, perhaps further evidence of the accidental nature of such gas accumulations when found immediately after the spinal insufflation.

The incidence of subdural filling over the convexity on the first-day films in our series was 15.4 per cent, as compared to 7 per cent reported by Davidoff and Dyke and 8.4 per cent by Von Storch and Buermann. Sixty-nine per cent of our cases showed filling of the same area on the second-day films.

Of some interest are those cases exhibiting unilateral filling of the subdural space. As a rule, the amount of gas, especially over the convexity, will differ on the two sides and not infrequently gas may be present on one side only. It seemed to us that posture might have much to do with this inequality. Accordingly, several patients were kept under close observation following the initial procedure of pneumoencephalography until the second-day roentgenograms were taken. Some were kept lying on one side and others were turned freely. In the latter cases subdural gas, when it occurred in the second-day roentgenograms, was always bilateral, while in the former it was found only in the side of the head that had been kept uppermost. Posture, therefore, would appear to have considerable influence upon the location of subdural accumulations and probably is the chief factor in most cases.

The free shifting of gas in the subdural space has been repeatedly demonstrated since we, uniformly, obtain roentgenograms in both upright and recumbent positions during the immediate examination. Thus, subtentorial gas may shift from under the tentorium to the subdural space over the convexity of the brain, and gas in this latter location always tends to accumulate in the uppermost side, depending upon the position of the head.

Two cases were reported by Pendergrass and Hodes (7) in which twenty-four-hour roentgenograms were of inestimable value in disclosing, in one instance, a poren-

cephalic cyst not seen on the first-day roentgenograms, and, in the other instance, filling of only one ventricle on the first-day roentgenograms but of both on the second-day. Our experience has been similar for occasionally porencephalic cysts have been seen on the first-day roentgenograms but not clearly demonstrated on the second-day. Similarly, the failure of one ventricle to fill should be an indication for second-day studies with posturing of the head so as to promote filling of the ventricle concerned.

SUMMARY AND CONCLUSIONS

A systematic study of the filling of the subdural space has been made following routine pneumoencephalograms and roentgenograms taken twenty-four hours later, in an attempt to elucidate the mechanism of subdural filling and its post-diagnostic significance. Subdural filling commonly occurs under the tentorium and the basal cisterna as a result of the introduction of gas into the spinal subdural space, whence it may also pass at times to the subdural space over the cerebral hemispheres. Under these circumstances it is obviously an artefact of technique. If one considers only the immediate roentgenograms or the twenty-four-hour roentgenograms separately, the mere presence of subdural gas cannot be shown to have any diagnostic significance. The routine study of second-day roentgenograms as well as the immediate roentgenograms, however, enables one to distinguish in many cases between such an artefact and the subdural filling which occurs as a result of subarachnoid lacerations. When gas is found in the subdural space twenty-four hours after pneumoencephalography when none had been present in the immediate roentgenograms, or when gas initially present had definitely increased in amount at the time of twenty-four hours, it can be assumed that there must be a tear or defect in the arachnoid membrane which occurred during or after intraspinal insufflation of gas. Such a finding occurs in a higher percentage of post-traumatic lesions than

oes in the other common categories of central nervous system disease. The presence of subdural gas under these circumstances may support a diagnosis of a post-traumatic lesion or other pathologic process producing adhesions between the arachnoid and dura, but it is not pathognomonic of such a condition.

The presence of subdural gas has no apparent relation to the degree of subarachnoid filling on the first day. On the other hand, subdural filling is greatest in those cases showing the greatest decrease in size of the ventricles on the second as compared to the first day. Ventricular collapse may be an important factor in promoting filling of the subdural space.

The ventricular size and filling are usually decreased on the second-day roentgenograms, but not infrequently an actual increase is observed. The possible explanations of this finding have been discussed.

Roentgenograms taken on the second day after encephalography are also of value for the following reasons:

(1) The shifting of gas from one ventricle to the other or in the subarachnoid or subdural space enables one to judge more accurately the significance of small differences of filling of various structures. Rarely, ventricular filling occurs on the second day when it did not occur on the first day.

(2) Certain pathological structures, notably porencephalic cysts, may be visualized on the second day where their presence was not suspected on the first-day roentgenograms.

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DISCUSSION

(Papers by Henderson and Sherman, Echternacht and Campbell, Wilson and Lutz, Paul and Erickson.)

Lt. Comdr. John D. Camp, (MC), U.S.N.R.: The paper by Dr. Henderson is particularly timely in view of the current interest in roentgenology of the skull. I think it is of the utmost importance, if we are to get the most from roentgenograms of the skull, that we establish more or less definite normals, and this is the largest group that I know of in which an attempt has been made to determine the normal and normal variations of the calvarium. I only hope that Dr. Henderson will carry his observations further in a group of children of different ages, so that the roentgenologist may have a standard for comparison with certain physical measurements, such as the circumference of the skull, to which the pediatrician frequently refers. That there is no constant relation between the volume of the head of the infant and its fetal size seems to me to be an important point, and one which may be of significance for the obstetrician.

Of the mid-line anomalies of the brain presented by Dr. Echternacht, it is, of course, obvious that a high percentage occurred in children. This is as might be expected, since these lesions are of congenital origin. Dr. Echternacht illustrated very nicely that there may also be tumors in this region. Tumors in the midbrain are very difficult for the neurosurgeon to remove. Since many of these lesions are more or less cystic, however, the patient can get some improvement by drainage and by establishment of a communication (if none already exists) between the cysts and the lateral or third ventricle.

I think it is well to point out, as I am sure Dr. Echternacht would have done had he had time, that communicating cysts of the cavum vergae may simulate pinealoma.

The paper by Dr. Paul and Dr. Erickson I think is significant in that it establishes fairly well that the diagnosis of so-called cortical

atrophy must be made with great caution. Several years ago one would make such a diagnosis very glibly, but the studies of Dr. Paul and those of our former colleague, Dr. Dyke, indicate the care that is required for this diagnosis.

The shift of air in the subdural space with the shift of position of the patient indicates the importance of posture and positioning in the procedures of encephalography and ventriculography. After all, these are mechanical procedures and, unless the ventricles and other spaces are thoroughly filled, we may be misled. If the ventricles are not completely filled, we must see that the head is properly manipulated during the examination so that all portions of the ventricular system at least are visualized.

Merrill C. Sosman, M.D. (Boston, Mass.): At Harvard, about a year ago, Mr. Churchill spoke of the use and value of Basic English and advocated its further extension. I think the first two papers in this group give us similar indications of the use of Basic Sciences in roentgenology, particularly, in the first paper, of anatomy and embryology. It is certainly true that a thorough knowledge of these sciences often gives the answer to obscure adult cases.

To illustrate, I would like to remind you of the overlapping of the parietal and occipital bones at the mid-line at the lambdoid suture, which often persists into adult life. The presumed fetal molding which causes the overlapping apparently persists here more than at any other place. If seen in the film of an adult who has sustained trauma to the area, this overlap is often interpreted as a dislocation or fracture of the suture in question. If one knows that this occurs in infants and may persist, he may be spared a grievous error.

Another Basic Science is pathology, and Dr. Echternacht has indicated some of the pathological changes that occur in addition to embryological and congenital anomalies.

As an excellent example of the Basic Science of anatomy, which often appears quite different to the radiologist than it does to the surgeon or even to the anatomist himself, I would like to remind you of Davidoff and Dyke's excellent monograph on "The Normal Encephalogram" (1937, Lea and Febiger), which should be in the library of every radiologist who does encephalography or ventriculography.

There is one interesting condition which occurs in association with agenesis of the corpus callosum—benign lipoma. I have seen 3 such cases, all identical. There are others, I am sure, which have not been reported. We have had 3 cases of agenesis of the corpus callosum which have not yet appeared in the literature, and I am sure if all the cases which have been recognized were added to the ones which Dr. Echternacht and his colleagues reported, we would have considerably more than the 20 which he noted. In all proba-

bility only 10 per cent of the cases have been reported. There are probably some two hundred which have been recognized by the radiologist or the neurologist before operation or autopsy.

Some of the older members of these Societies will remember an outstanding radiologist when he was called on to discuss a paper and every often when he was not called upon, would get up and show about six cases of what had been presented as a very rare and unusual condition. I am taking the liberty of showing one case. At this point Dr. Sosman showed several slides. In the direct lateral view, with no air injection, an area of decreased density exactly in the mid-line of the skull is seen. There are, around this area of decreased density, faint areas of calcification. An anteroposterior view also shows the faint area of decreased density present in the lateral film to be exactly in the mid-line. Now the only thing possible which could give an area of decreased density in the intracranial substance, if no air has been injected—and this is not quite dark enough to be air—would be fat. The only logical diagnosis or assumption, therefore, from a plain roentgen examination like this is that we are dealing with mid-line lipoma of the brain. I think Dr. Echternacht will agree that the encephalogram is characteristic of agenesis of the corpus callosum. The patient in question suffered epileptic attacks and was also mentally deficient.

Interestingly enough, all 3 of the cases of intracranial lipoma which I have seen—all of them confirmed—have been associated with agenesis of the corpus callosum. So if you have a mid-line lipoma of the brain, I think you may assume that you have associated with it agenesis of the corpus callosum.

The final slide shows a series of intracranial lipomas which have been collected from the literature, indicating that most of these are located at the mid-line. Many of them were small lipomas of no consequence, found at autopsy. We intend to report this group of cases later.

As to Dr. Paul's paper, again the importance is in recognizing subdural air as a normal condition, particularly twenty-four hours after the encephalogram is made. A group of such cases was reported from a psychopathic hospital recently with the claim that the presence of subdural air was incontrovertible evidence of cortical atrophy in the insane. The authors did not recognize how frequently this observation is made in normal patients.

One final word as a possible addition to the symposium: those of you who deal with these patients realize that many of them have severe headaches after encephalography. These headaches may be promptly benefited and their duration shortened if the patient is given oxygen either in an oxygen tent or by mask. This hastens the rapid absorption of intracranial air by its exchange with the oxygen in the blood.

The Treatment of Late Post-Irradiation Ulcers with Radon Ointment¹

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THIS REPORT is concerned with the treatment of radiation skin ulcers with alpha particles from radon. The utilization of alpha-radiating agents in post-irradiation ulcers was first suggested in 1925 by Fabry (1-3), who used Thorium X concentrations from 1,500 to 2,000 electrostatic units per gram vaseline base. The ointment was left in place two to three days, and the treatment was repeated after three to six weeks. The favorable results reported by Fabry were confirmed by Delmes (4), who employed considerably smaller doses (20 e.s.u.). Jessner (5) obtained similarly good results using an ointment containing Thorium X marketed under the name of Doramad and containing 2,000 e.s.u. per gram of ointment. The most extensive studies in the treatment of post-irradiation skin reactions with alpha radiation are those of E. Uhlmann (6-13) undertaken in 1929. The encouraging clinical results demonstrated by Uhlmann convinced us that this method of treatment deserved further study.

Skin changes following radiation therapy have become more common in recent years. The reason for this increased frequency is the far more intensive irradiation employed in the last two decades. The cutaneous reactions which occur as immediate sequelae of treatment, erythema and radio-epidermite, are anticipated as the result of intensive irradiation, while reactions which occur after an interval of about six months are unpredictable. When late sequelae of intensive irradiation occur, they vary considerably in their degree of severity. In the order of frequency of occurrence, they are patchy pigmentation, depigmentation, atrophy, telangiectasia, subcutaneous sclerosis, ulceration, hyperkeratosis. These skin changes have been

known since the early days of medical use of x-rays and radium. Originally they could almost invariably be traced to faulty technic, inadequate protection, or to occupational exposure. The great advance in knowledge of radiation physics and biology and the subsequent development of modern technic have provided means of proper protection, but skin reactions persist, necessitating a new approach from both a medical and legal standpoint.

From the legal point of view, the post-irradiation skin reaction should be regarded properly as an unavoidable and unpredictable aftermath of the therapeutic method, unless evidence of negligence or gross lack of knowledge on the part of the practitioner can be shown to exist.

From the medical standpoint, skin reactions occurring immediately after radiation treatment heal spontaneously, as a rule, in four to six weeks after completion of exposure, whereas delayed skin reactions, occurring after about six months or later, may not regress spontaneously and therefore demand attention. Atrophy of the skin and telangiectasia do not require treatment, except for cosmetic reasons. Ulceration and hyperkeratosis must have immediate and special care. The rare occurrence of post-irradiation cancer is beyond the scope of this study.

Medical, surgical, and radiation methods have been used in the treatment of post-irradiation ulcers and hyperkeratoses, with various degrees of success. Each method has its advocates. Little agreement, however, exists on the subject.

Evaluation of the therapeutic methods employed necessitates consideration of the histopathology of the skin changes. The salient feature of late irradiation tissue reactions is impaired vascularity. The degree of the subsequent sclerosis of the skin

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is determined by the extent of obliteration of the subpapillary capillaries and deep cutaneous vessels. When the disturbed vascular supply is further interfered with by some minor external injury, ulceration follows. Microscopically such ulcerations present the typical signs of tissue necrosis, and the clinical course is identical with that of an indolent ulcer of any etiology. The response of a post-irradiation ulcer to treatment will depend not only on the extent and the degree of impaired vascular supply but also upon the action of the therapeutic agent in separating the necrotic tissue and in assisting the restoration of the blood supply.

When the ulcer extends to bone or involves deep fascial layers, surgical excision of the entire scar and part of the surrounding healthy tissue is the method of choice. The surgeon is often limited, however, by the underlying vital organs and by difficulty in demarcating the extent of the blood vessel changes beyond the visible scar. Occasionally superficial ulcers heal following applications of astringents or protective or tissue-stimulating ointments, such as chlorophyll ointment, aloe vera, and others. More extensive and deeper ulcers are not amenable to this type of treatment.

The variable results of medical and surgical treatment of irradiation ulcers and hyperkeratoses and the recognition of their nature as the outcome of an obliterating endarteritis have encouraged some dermatologists and radiologists to apply radiation to these lesions. The treatment of obliterating endarteritis of any etiology by this means appears justified, since radiation in small doses produces temporary vasodilatation. The vasodilatation increases the blood supply and leads to demarcation of the ulcer, to separation of the necrotic tissue, and finally to healing with a healthy, well vascularized scar.

The indications for radiation therapy of late irradiation reactions were agreed upon by numerous investigators (14, 15), who, however, employed different radiating agents, such as ultraviolet rays, x-rays,

gamma rays, alpha particles, and beta particles (16-20). Radon in an ointment base was chosen for use at the University of California because of the physical properties and biological actions of alpha radiation and because of Uhlmann's encouraging results.

In view of the fact that the average range of the alpha particles is 0.135 mm. in tissue (3.9 cm. in air), it might be inferred that only the alpha particles escaping from the most superficial layers (0.01 to 0.05 mm.) would exert biologically effective ionizing action. In the therapeutic use of radon ointment, however, such a calculation is erroneous because of the diffusion of the gas from the vehicle (21-23). It has been shown experimentally that radon is absorbed even through intact skin, and radon can be demonstrated in the blood and exhaled air of patients placed in radon water baths. Thus, in therapeutic applications the effect is not limited to the superficial layers. The radon gas, due to the diffusion from the ointment base and absorption by the skin, reaches the deeper layers as well. These facts indicate that far more alpha particles reach the therapeutic target than can be calculated from the surface or half-solid angle effect of a given thickness of ointment. On the other hand, radon diffuses out of the ointment base gradually; therefore, the effective radiation per unit time is only a fraction of the disintegration of particles contained in the ointment. The total effective radiation is a function of the amount of ointment applied, the amount of radon contained in the ointment, the duration of application, the temperature of the ointment, and the thickness of the layers of the ointment. In clinical applications this last factor, because of the thin layers used, is negligible.

Happel and Brünauer (23, 24) studied erythema and pigmentation of the skin with radon. They found that applications of radon ointment, 50 to 100 c.s.p. per gram of vaseline, for ten to twelve hours, in some cases caused a distinct erythema and even pigmentation. Uhlmann, however, stated that in his opinion the ef-

thema is due not to radiation, but rather to sensitivity of the skin of some persons to lanolin or vaseline. Our experience in this regard suggests rather that radon in concentrations of 50 to 100 e.s.u. per gram of vaseline may produce erythema. In most of our cases after the third or fourth treatment an erythema was observed. This reaction, as a rule, subsided within eight or ten days. Pure vaseline applied to control areas in these patients produced no erythema.

The objection that the amounts of radiation used in these treatments were too small to produce an erythema becomes invalid when one considers that this treatment utilizes alpha and not gamma radiation. For equal physical exposures, the biological effect of alpha radiation is considerably greater than that of gamma rays, the ratio being approximately 9 to 1 (15). An explanation for this greater biological effect might be the greater density of ionization produced by alpha particles (4,000 ion pairs per micron) as compared with that produced by gamma rays (441 ion pairs per micron).

The radon ointment, said to contain 100 e.s.u. on the day of preparation, was kindly supplied by E. Uhlmann and distributed by the Michael Reese Hospital in Chicago. Recently a radon ointment has been put on the market by the Canadian Radium and Uranium Corporation under the name of "Alphatron." The activity of the ointment is given in electrostatic units.

The definition of the strength of radioactive preparations in electrostatic units is objectionable for at least two reasons: first, very few radiologists are familiar with the definition of radioactivity in these units; second, the ionization method of measuring alpha radiation directly is not accurate. This is especially true when the source of alpha radiation is carried in a vehicle. These reasons are enough to make it desirable to express amount of radioactivity in "curies," where one curie is equal to 3.7×10^{10} atoms disintegrating per second, irrespective of the kind of radiation emitted. Converted into these terms, 100 e.s.u. equal 36 microcuries of

radon. The obvious advantage of this definition is that it provides a uniform standard for the measurement and expression of radioactivity in any material.

According to the directions of Uhlmann, the radon ointment "should be applied in a 3- to 4-millimeter layer over the altered skin area and covered immediately with a piece of rubber dam, or oil cloth, or cellophane of suitable size. It is held in place by adhesive strips under which absorbent cotton has been placed. The adhesive is laid down in overlapping strips to prevent the escape of the radon into the air. The dressing is left in place for eight hours and then removed by the patient. The treatments are repeated at intervals of seven days. During the interval between treatments the skin must not be irritated by any medication and is best covered by a 10 per cent boric beryllium ointment."

The dose per individual treatment in our cases was the same as that used by Uhlmann. The time necessary to deliver this dose, however, had to be increased to account for the decrease in activity during the time of transportation of the ointment from Chicago to San Francisco. The treatment time varied from ten to eighteen hours.

In general, treatments were given at weekly intervals, as suggested by Uhlmann. In some patients erythema and increased tenderness at the site of application developed after the third or fourth treatment. This was considered as a reaction to the treatment. In the first few cases no change in technic was made. In the later cases, before subsequent treatment was given, the reaction was allowed to subside. This usually required eight to ten days. The treatments were continued until the ulcer healed or the hyperkeratosis disappeared. The total number of treatments in our patients varied from three to twenty-eight. In all patients during the interval between treatments the skin was covered with 10 per cent boric acid ointment.

Airtight latex caps were used to cover the ointment. Latex does not irritate the skin. Caps can be prepared so as to fit

CASE 3: R. I. Female, aged 84, treated with superficial x-rays for squamous-cell carcinoma of the left with regional metastasis. Two courses of treatment were given six months apart: the first course 6,000 r, the second 5,000 r (air). Ulcer appeared twenty-six months after the second course. Routine medical treatment of ulcer for six months unsuccessful. Picture No. 1 taken thirty-two months after the second course of treatment. Picture No. 2 made two months after institution of radon ointment treatment.

CASE 21: C. P. Male, aged 65, received repeated x-ray and radium treatments from 1936 to 1940 for basal carcinoma of right nasolabial fold. Ulceration first occurred in 1940. Picture No. 1 taken February 1943, before institution of radon ointment treatment. Picture No. 2 shows condition after three months of radon ointment treatment.

CASE 23: L. F. Female, aged 25, treated with fast neutrons generated by cyclotron in September 1941, for carcinoma of the left parotid gland. Moderate skin atrophy and telangiectasis followed shortly after treatment. Ulcer appeared twenty-six months after treatment. Picture No. 1 shows ulcer following routine medical treatment. Picture No. 2 shows ulcer after a 3-month course of radon ointment treatment.

CASE 24: C. M. Male, aged 68, treated with fast neutrons in February 1943, for metastatic carcinoma of left submaxillary gland. Ulcer developed ten months after treatment. Picture No. 1 shows ulcer after 3 months of routine treatment. Picture No. 2 shows condition after a 10-month course of treatment with radon ointment.

CASE 28: J. W. Male, aged 62, treated with fast neutrons in April and May 1942, for carcinoma of prostate. Ulcer first appeared twelve months after completion of treatment. Routine treatment with boric acid ointment for two weeks. Picture No. 1 and Picture No. 2 show ulcer before and after a three-month course of treatment with radon ointment.



Case 3



Case 21



Case 23



Case 24



Case 28



Figs. 1 and 2. Latex caps covering radon ointment.

ny part of the body and in any thickness. his method was adopted to prevent the urther extensive skin reactions which had een observed in patients sensitive to adhesive tape. Moreover, we found that in ertain parts of the body it was not possible o make an airtight dressing with adhesive ape. The latex caps were prepared hrough the generous co-operation of Dr. Charles S. Lipp, of the Department of Dentistry of the University of California. iquid latex is poured over a mold of appropriate size and shape and is left to cure. The latex caps were held in place by liquid dhensive. For patients who exhibit sensitivity to liquid adhesive, the cap can be made thick enough to adhere by suction, and it can be kept in place by an ordinary bandage. It might be mentioned that the assive hyperemia caused by suction may e of additional therapeutic value. (Figs. 1, and 2.)

Latex has been tested for permeability or radon and was found to be radon-tight. Radon ointment was put in a flask-shaped latex container with 3 mm. wall thickness. This was closed with a rubber cork and sealed with liquid adhesive. The sealed latex flask was placed in an airtight box.

After twenty-four hours no active deposit was detected on the walls of the box.

All patients with late radiation skin reactions were seen in the Visible Tumor Clinic of the University of California by at least three dermatologists, one surgeon, and one radiologist. Only patients who failed to respond to other medication and were referred upon the consensus of the Visible Tumor Clinic were treated with radon ointment. The history in every instance revealed some minor trauma as immediate cause of ulceration.

In the period from November 1942 to Jan. 1, 1945, 28 patients were treated with radon ointment for post-irradiation ulcers. In Table I, giving the results of treatment, these patients are classified in relation to the type of radiation to which they were primarily exposed: 19 to x-rays, 2 to radium and x-rays, 7 to neutrons.

Of the 19 x-ray patients, 1 had been exposed to diagnostic x-rays, 16 had received x-ray treatments for cancer, and 2 had received repeated x-ray treatments for non-malignant skin disease. The ulcers of 12 of these 19 patients healed completely after one course of radon ointment treatment. The courses varied from two to sixteen.

treatments given over a period of from two to twenty weeks. Two patients whose ulcers healed completely after one course had additional radon ointment treatment following recurrence of the ulcers after new trauma. In one of these patients a single additional treatment and in the other patient five more treatments over a period of five weeks were sufficient to bring about the epithelization of the ulcers. *Three of the nineteen patients showed improvement, but the ulcers have not as yet healed. These patients are still under treatment. Four patients of this group showed no improvement. In three of the latter patients the ulcer was proved to be due to malignant growth, and in one patient the ulcer extended to bone.*

The ulcers of the two patients who had been exposed to x-ray and radium treatments for carcinoma of the skin healed completely after radon ointment treatment. In one patient who had had a post-irradiation ulcer for fifteen years, nine applications of radon ointment over a period of ten weeks sufficed for healing. In the other patient, who had had the ulcer for several years, seven treatments over a period of twelve weeks brought about complete healing.

In 5 of the 7 patients who had had neutron therapy for a malignant neoplasm the ulcers healed after one course of radon ointment treatment. From three to twenty-eight treatments were given over a period of from four to forty-three weeks. One patient improved only. This patient had been treated with neutrons through two fields for cancer. Eleven months after completion of treatment herpes zoster developed in one of the two fields and its corresponding segment. Some kind of electrotherapy was given to this area, after which five ulcers appeared. Three of these healed, while two only improved, under radon ointment treatment. The treatment had to be interrupted because the patient's general condition became progressively worse. One patient, with an ulcer extending to and involving the bone, showed no improvement.

TABLE I: RESULTS OF RADON OINTMENT TREATMENT

Radiation Ulcers Follow- ing Exposure to	Healed	Improved	Not Improved	Tot.
X-rays	12	3	4	19
X-rays + Ra- dium	2	1	1	4
Neutrons	5	1	1	7

In Table I the outcome of the radon ointment treatment is summarized, while in Table II a short analysis of each case is given.

The outstanding feature of radon ointment treatment in all the patients who responded to it was prompt disappearance of pain. Survey of the case histories indicates that the healing is slow when the ulcer is located in skin regions where there is little underlying subcutaneous tissue and that radon ointment is of no avail when the ulcer extends to tendon or bone.

When inflammation from secondary infection develops in the ulcer, healing is retarded. Nevertheless, the radon treatment should be continued. Between treatments, sulfathiazole ointment or penicillin ointment might be used instead of boracic acid ointment. In 2 of our patients, when secondary infection was cleared up, the ulcer healed promptly. Care must be exercised to prevent the development of secondary infection. The latex cap worn even during the intervals between treatments serves as a good protection from injury and infection.

In none of our patients has any untoward effect been noted which could be traced to radon ointment.

SUMMARY

1. Twenty-eight patients with post-irradiation ulcers have been treated with radon ointment. The length and management of the treatment depended upon the individual case.

2. The radon ointment used contained 36 microcuries of radon per gram of vaseline on the day of preparation.

3. The dose delivered from a given

TABLE II: DETAILS OF CASES

Case Number Name Age Sex	Location and Field Size Exposed to Radiation	Approximate Extent of Ulcer	Interval from Exposure to Radiation to Appearance of Ulcer and Previous Treatment of Ulcer	Number and Duration of Radon Ointment Treatments	Result and Period of Observation Since Healed	Remarks
B.	Right temporo-occipital, including ear lobe, 15 × 15 cm.	8 separate ulcers from 0.9 to 1.5 cm. in diameter; 1 hyperkeratosis 0.6 cm. in diameter	42 months after diagnostic x-rays and Sulfathiazole ointments, aloe vera, 4 months	37 treatments 18 months	Healed; 5 ulcers 22 months; 1 hyperkeratosis 9 months; 3 ulcers 5 months	Lesions occurred subsequently as grouped, and each was at different location
W.	Left chest	1.5 cm. in diameter	12 months after treatment with x-rays Boric acid ointment, 2 months	2 treatments 1 month	Healed 26 months	
I.	Left auricular and mandibular regions, 6 × 9 cm.	1 cm. in diameter	26 months after treatment with x-rays Boric acid ointment, 6 months	7 treatments 2 months	Healed 15 months	
W.	Right cheek, 3 × 5 cm.	2 × 1.5 cm.	3 months after treatment with x-rays Boric acid and sulfathiazole ointments, 3 months	11 treatments 3 months	Healed 13 months	
B.	Dorsum of left hand	1 cm. in diameter	5 months after treatment with x-rays Self medication, 5 months	33 treatments 11 months	Healed 10 months	2 courses 6 months apart; after healing following first course, breakdown due to new injury
B.	Right chest	2 cm. in diameter	12 months after treatment with x-rays Boric acid ointment, 2 months	23 treatments 14 months	Improved	5 courses, repeated breakdown after primary healing
B.	Dorsum of right middle finger, 2.5 cm.	2 cm. in diameter	29 months after treatment with x-rays Aluminum acetate cold cream; boric acid ointment, 6 months	5 treatments 5 weeks	Healed 16 months	
B.	Right side of temple, 6 × 7 cm.	1 × 1.5 cm.	5 months after treatment with x-rays Boric acid ointment, 2 months	16 treatments 5 months	Healed 21 months	
S.	Left ear lobe	0.5 cm. in diameter	4 months after treatment with x-rays 1% benzocaine and boric acid ointments, 2 months	12 treatments 4 months	Healed 11 months	
F.	Dorsum of left hand, 2 × 1.5 cm.	0.3 cm. in diameter	10 months after treatment with x-rays Self medication, boric acid ointment, 2 months	29 treatments 9 months	Healed 13 months	
E. C.	Left cheek, 5 × 6.5 cm.	1 cm. in diameter	3 months after repeated treatments with x-rays Boric acid ointment, 2 months	5 treatments 6 weeks	No improvement	Active malignant growth proved by biopsy

Table cont. on p. 156

TABLE II: DETAILS OF CASES—*cont.*

Case Number Name Age Sex	Location and Field Size Exposed to Radiation	Approximate Extent of Ulcer	Interval from Exposure to Radiation to Appearance of Ulcer and Previous Treatment of Ulcer	Number and Duration of Radon Ointment Treatments	Result and Period of Observation Since Healed	Remarks
12 O. J. 79 m	Left cheek, 3 × 2 cm.	0.7 × 1 cm.	Approximately 3 years after treatment with x-rays Ointments, self medication, 2 years	6 treatments 8 weeks	Healed 15 months	
13 C. L. 68 m	Posterior neck, 10 × 10 cm.	4 × 8 cm.	26 years after treatment with x-rays Boric acid and sulfathiazole ointments, aloe vera, 3 months	13 treatments 5 months	No improvement	Ulcer extended to bone
14 M. R. 39 f	Face, 10 × 10 cm.	0.5 cm. in diameter, on septum of nose	20 years after treatment with x-rays Ointments, repeated plastic surgery, 5 years	14 treatments 5 months	No improvement	Ulcer was healed to be to mal growth
15 E. Z. 61 f	Nose, 4 × 4.5 cm.	1 × 1.5 cm.	14 months after treatment with x-rays Boric acid ointment, 3 months	15 treatments 4½ months	Healed 4 months	
16 L. T. 61 f	Naso-orbital region, 2.5 cm. in diameter	0.5 cm. in diameter	7 months after treatment with x-rays Boric acid ointment, 3 months	8 treatments 2 months	No improvement	Ulcer was healed to recur of mal growth
17 E. S. C. 43 m	Sole of foot	4 × 5 cm., involving whole heel	8 years after treatment with x-rays Ointments, sulfathiazole ointment, aloe vera; self medication, 2 years	25 treatments 6 months	Very marked improvement; treatment continues	Amputation of foot was considered surgeons. This was the most disagreeable appearance. Present 1.5 cm., clear well healing
18 A. C. 59 f	Dorsum of right hand and forearm	0.5 cm. in diameter, on dorsum of hand	10 years after treatment with x-rays and radium Self medication, boric acid and sulfathiazole ointments, 5 years	9 treatments 2½ months	Healed 3 months	
19 A. F. 45 f	Anterior abdomen, 15 × 15 cm.	5 cm. in diameter, periumbilical	4 years after treatment with x-rays Boric acid and sulfathiazole ointments, 2 months	23 treatments 6 months	Improved; treatment continues	Numerous angiectases whole abdomen
20 A. C. 71 f	Left cheek and nasolabial fold, 3 cm. in diameter	0.5 cm. in diameter	5 years after treatment with x-rays Ointments and self medication, 25 years	4 treatments 1 month	Healed 18 months	

Table cont. on p. 1

amount of radon ointment is not a mere surface effect, but also a function of the temperature-dependent rate of diffusion of the radon from the ointment, the absorption by the skin, and the duration of application.

TABLE II: DETAILS OF CASES—*cont.*

Case Number Name Age Sex	Location and Field Size Exposed to Radiation	Approximate Extent of Ulcer	Interval from Exposure to Radiation to Appearance of Ulcer and Previous Treatment of Ulcer	Number and Duration of Radon Ointment Treatments	Result and Period of Observation Since Healed	Remarks
P.	Right nasolabial fold, 3 cm. in diameter	1.7 X 1.5 cm.	Indefinite; had repeated treatments with x-rays and radium since 1936 Ointments and self medication, several years	7 treatments 3 months	Healed 23 months	
F.	Sacrum, 10 X 10 cm.	4 separate ulcers, 1.5 cm., 3 cm., 1 cm., and 2 cm.	4 months after treatment with neutrons Boric acid and chlorophyll ointments, boric acid compresses, 4 months	22 treatments 9 months	Healed 2 months	Patient expired Dec. 10, 1943
F.	Left parotid region, 10 X 10 cm.	1 cm. in diameter, on left ear	26 months after treatment with neutrons Boric acid ointment, aluminum acetate, sulfathiazole ointment, 6 weeks	13 treatments 3 months	Healed 15 months	
M.	Left side of jaw and neck, 10 X 15 cm.	1 cm. in diameter	10 months after treatment with neutrons Boric acid ointment, 3 months	28 treatments 10 months	Healed 6 months	
K.	Pubic region and root of penis, 10 X 10 cm.	0.4 cm. in diameter, at root of penis	24 months after treatment with neutrons Boric acid ointment, 2 months	3 treatments 4 weeks	Healed 15 months	
M.	Left shoulder, 10 X 10 cm.	5 cm. in diameter, over acromion, exposing bone	3 months after treatment with neutrons Chlorophyll, boric acid, and sulfathiazole ointments, 5 months	12 treatments 4 months	No improvement	Ulcer extended and involved bone
R.	Paravertebral posterior 10 X 15 cm.	5 ulcers, 1 to 2 cm. in diameter	12 months after treatment with neutrons Sulfathiazole and boric acid ointments, 3 months	25 treatments 8 months	3 ulcers healed; 2 ulcers improved; 3 months	Treatment interrupted. Patient died of coronary thrombosis
W.	Pubic region and root of penis, 10 X 10 cm.	1 X 0.5 cm., pubis	12 months after treatment with neutrons Boric acid ointment, 2 weeks	12 treatments 3 months	Healed 19 months	

4. Latex caps were used to insure airtight application of the ointment.

5. The reaction occurring after the third or fourth weekly treatment is a true erythema which subsides in eight to ten days.

6. Radon ointment is indicated in any post-irradiation ulcer, is preferable to any other non-surgical method of treatment, and does not interfere with healing if indication arises for surgical intervention.

7. The radon ointment treatment resulted in alleviation of pain and healing of the ulcers, provided there was no extension of the ulcer to bone and that the ulcer was not due to malignant growth.

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The Treatment of Hemangioma¹

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MANY EXCELLENT papers have been written on the treatment of hemangioma. In nearly all of them the advantages of some particular method of treatment have been extolled. This paper is based on experience with 520 cases. Its



Fig. 1. Case I: M. B., a girl of 6 months, referred by Dr. M. B. Hartzell of Philadelphia, on Oct. 16, 18.
A. Cavernous hemangioma involving the left nasolabial fold, treated with a radium plaque made up with 5-mg. element tubes, with 0.5 mm. silver + 1.0 mm. rubber filtration, applied for one hour. Treatment given Dec. 15 and again on Dec. 18, 1918, for forty minutes.
B. Child well, July 8, 1919.
C. Perfect result, Nov. 19, 1940, after twenty-two years.

object is to show the advantage of selecting the form of treatment according to the conditions present.

The method of treatment of hemangioma should vary with the type or character of the lesion, its size, its location, and the age of the patient. I am, therefore, not advocating any particular method of therapy for all cases. I shall try to present the indications for each type of treatment, and

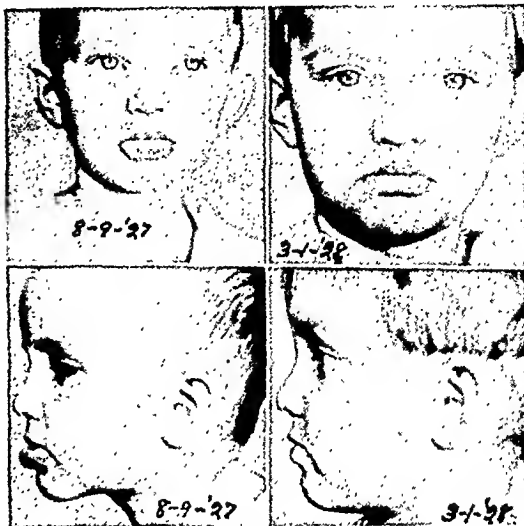


Fig. 2. Case II: W. L., female child, age 4 years, referred by Dr. Wm. E. Magaziner of Philadelphia, on July 26, 1927. Cavernous hemangioma of the entire lower lip, treated with a plaque made up with six 10-mg. radium needles, walls 0.4 mm. monel metal, 1.0 mm. brass + 1.0 mm. rubber filtration, at a distance of 2 mm. Surface applications were made for one hour on July 27, Aug. 2, 5, 9, 16, 1927. On Sept. 14, 1927, five 10-mg. radium needles were inserted into the tumor tissue for two hours. Perfect result shown March 1, 1928.

demonstrate some of the results which I have obtained by each. I have found no satisfactory treatment for the portwine type. In these, x-rays have produced atrophy and telangiectasis; radium does the same, and, in addition, the appearance is apt to be blotchy; electrodesiccation gives scarring, and in at least one case I had to treat a keloid afterward.

As radiologists, we naturally think first of treatment with radium and/or x-rays (Andren, Andrews, Pohle, Brown, MacKee, Schmidt, Baensch, Nielsen, Harwell). Hodges has especially recommended treatment as early as possible. In general, and for the greatest number of cases, I believe that radium is the most useful, especially when the lesions are relatively superficial—

¹ Presented at the Joint Meeting of the American Roentgen Ray Society and the Radiological Society of North America, Chicago, Ill., Sept. 24-29, 1944.

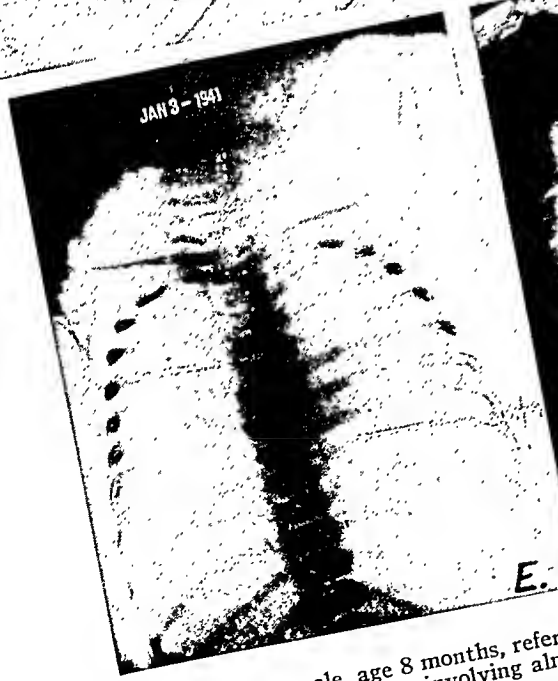
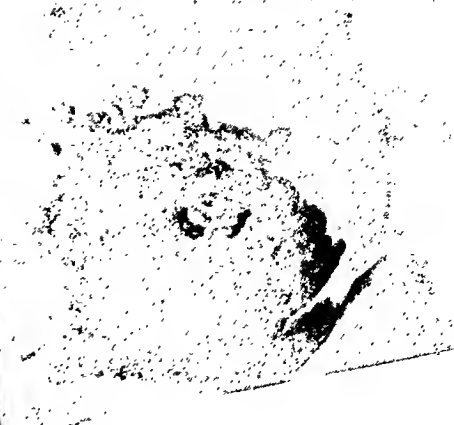
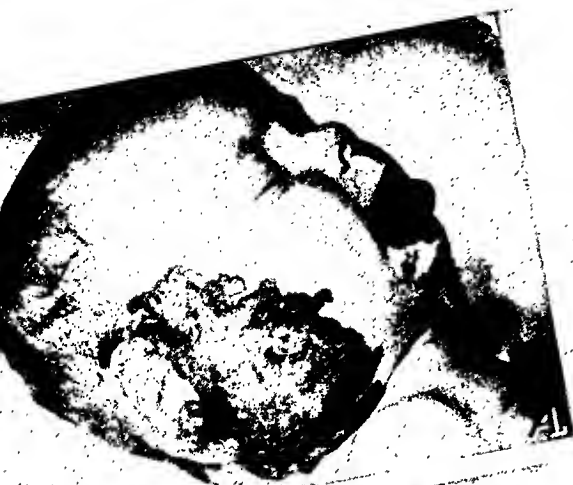


Fig. 3. Case III: J. H., female, age 8 months, referred by W. R. Little of Trenton, N. J., on Jan. 3, 1941. A, B, and C. Cavernous hemangioma involving almost the entire right side of the face, neck, lip, and lesions also on the left side of the scalp and left arm. None of these was present at birth. The first lesions appeared on the lip at the age of six to eight weeks and on the right cheek at about three months. They had grown rapidly. In June 1940, lesions appeared on the left temporal region and on the left arm. The patient was in the Jefferson Hospital in July 1940, under the care of Dr. Warren B. Davis, on account of right middle ear disease, which was treated successfully. While in the hospital, the child began to wheeze, and by bronchoscopic examination, Clarf found obstruction in the trachea due to pressure of a tumor on the right side of the neck. An x-ray of the chest (E) showed compression by the tumor against the trachea and the larynx, but there was no tumor formation within the chest. The case looked so hopeless that I at first refused treatment. The child was brought back on Jan. 21, 1941, when treatment was urgently requested by the parents. The following radium applications were made:

more than 1 or 2 cm. in depth. I have in some cases used both radium and x-rays in the same case. Some good results have been obtained and reported by various authors with each kind of radiation—high voltage and high filtration, low voltage and moderate filtration, and contact therapy with very low voltage and little filtration (Hodges, Kerr, Pendergrass, and others).

RADIUM: INDICATIONS AND ADVANTAGES

Treatment with radium is indicated especially in children, because it can be applied without pain and without an anesthetic and can be retained by adhesive plaster without immobilizing the patient. In addition, the after treatment requires dressings and no other special measures. Even in adults, most of these advantages exist. Generally, hemangiomata of the venous and strawberry types are rela-

tively superficial. It is to these types that this paper refers. It is always desirable to limit depth dosage as much as possible, when it is not needed. I am convinced that it is neither desirable nor, indeed, entirely harmless to irradiate normal tissue when it can be avoided, and I always try, so far as is possible, to confine irradiation to the diseased tissue. This is why careful diagnosis and good clinical judgment are necessary in radiation therapy, and why it cannot be turned over to technicians. Medical training is essential.

Radium has, relatively, a local and superficial effect. The inverse-square law applies but is complicated by the fact that one must usually use multiple foci. It is my impression that for the treatment of hemangioma, the highly filtered radium rays (gamma rays) give a better cosmetic result. Andrews also is of this opinion. The dermatologic composition plaque can

Fig. 3. Case III.—*cont.*

Date	Amount	Filter	Distance mm.	Time hr.	Region
11-41	6 × 10 mg.	1 mm. Pt + 1 mm. rubber	2	1	Lower lip
10-41	6 × 10 mg.	1 mm. Pt + 1 mm. rubber	2	1½	Lower lip
10-41	6 × 10 mg.	1 mm. Pt + 1 mm. rubber	2	1½	Lower lip
11-41	3 × 10 mg.	1 mm. Pt + 1.5 mm. rubber	2.5	1	Lower lip (outer side)
18-42	4 × 10 mg.	1 mm. Pt + 1 mm. rubber	2	1½	Lower lip (outer side)
22-42	2 × 25 mg.	1 mm. Pt + 1 mm. rubber	1	1	Lower lip (inside)
20-41	3 × 10 mg.	1 mm. Pt + 1 mm. rubber	5	2	Left temporal
20-41	6 × 10 mg.	1 mm. Pt + 1 mm. rubber	5	2	Areas on chin
20-41	15 × 10 mg.	1 mm. Pt + 1 mm. rubber + gauze	7.5	1½	Back of right ear
20-41	14 × 10 mg.	1 mm. Pt + 1 mm. rubber + gauze	5	2	Back of right ear
22-41	11 × 10 mg.	1 mm. Pt + 1 mm. rubber + gauze	5	2½	Back of right ear
22-41	10 × 10 mg.	1 mm. Pt + 1 mm. rubber + gauze	5	2½	Front of right ear
28-42	5 × 10 mg.	1 mm. Pt + 1 mm. rubber + gauze	2	1½	Front of right ear

In addition to the radium treatment, in order to affect the deep tumor in the neck, which was entirely under the skin, roentgen therapy was given as follows: on Jan. 30, 1941, 200 r and on Feb. 20, 300 r, directed into the anterior portion of the neck toward the tumor tissue (portal, 80 sq. cm., 180 kv., 15 ma., 9 min., 52 cm. distance, 2 mm. copper filtration); on Oct. 30, 1941, 300 r low-voltage radiation, directed over the right ear and the left parotid region (5 ma., 8 min., 30 cm. distance, 2 mm. aluminum filtration); on Jan. 21, 1941, 200 r, Feb. 6, 300 r, and March 20, 300 r, directed anteriorly over the trachea and neck (portal of entry, 80 sq. cm., 180 kv., 15 ma., 9 min., 52 cm. distance, 0.5 mm. copper filtration).

First of all, I made plaques of radium, using 10-mg. units, with 1.0 mm. platinum filtration (= 2 mm. lead). The distance was 2 to 5 mm. but the radium was so placed that an even radiation was obtained, and when the whole area was treated as much as 210 mg. were used. The lip was treated separately. I built a plaque around the lip and the other small lesions I treated with small plaques such as are used in dermatology, since the process is relatively superficial. I used low-voltage rays over part of the lip, to get a general effect, and high-voltage rays (200 kv., 0.5 mm. copper) on the neck, because here there was no surface lesion and the object was to get an effect on the hemangioma in the deep tissues, where it was causing compression. I was most fortunate in obtaining a shrinkage of this mass deep in the neck. It is all a matter of choosing rays which will be directed to the area that one wants to affect; but the dosage must be even. One can probably treat these large lesions with roentgen rays, but a more beautiful cosmetic effect is probably obtained with radium.

D and F. At present, we have a healthy child with practically all evidence of hemangioma gone. She has no wheezing or obstruction to breathing. There remains a slight, almost invisible thickening of the lower lip, which will probably shrink further. I usually count on about two years to get the full effect of the radiation.



Fig. 4. Case IV. A. G., female, age 8 months, referred by Dr. C. B. Lerch of Pottstown and Dr. Butterworth of Reading, on Oct. 16, 1942.

A. Cavernous hemangioma involving the nose and left orbital region. The patient had been treated previously by carbon dioxide snow, which had caused some pallor and scarring on the surface, but the deep remained. Inasmuch as the lesion covered the eye and involved the lids and the inner canthus, I placed shield under the lid and protected the eye with 1 mm. brass. X-ray treatment was then given with equipment (130 kv., 5 ma., 5 min., 30 cm. distance, 2 mm. aluminum filtration) for a 50 per cent erythema or 260 r. This was repeated on Oct. 29, Nov. 12, Dec. 3, and Dec. 22, 1942, and Jan. 26 and March 1943, giving a total dose of low-voltage x-rays amounting to 1,760 r (in air).

B. Shrinkage of the cavernous tumor tissue following treatment; considerable thick, dense tissue remaining.

C. On April 16, 1943, I introduced into the thickest part of the remaining tumor, in the larger area 10-mg. radium needles with 0.4-mm. monel metal walls. Four 10-mg. needles with 0.3 mm. iridioplatinum walls of smaller size, were used for the areas of less thickness. The needles were left in place for 48 hours, giving a total dose of 280 mg. hr. On July 27, 1943, fifteen 10-mg. monel metal radium needles were arranged in three plaques and applied at a distance of 5 mm. to the remaining thickened portions. On July 28, four 10-mg. needles were applied for one and a half hours as a surface plaque. There has been no treatment since that time.

D. At present, all evidence of tumor tissue has disappeared, but the scar tissue, which I believe to be the carbon dioxide snow, remains. A plastic operation is contemplated.

be used on small and very superficial lesions but I usually use plaques or surface applicators made up of 10 mg. element units, with 1.0 mm. of platinum filtration (= 2 mm. lead). These plaques are made to fit exactly the lesion treated, and have varied from two to thirty-five units (20 to 350 mg.), according to its size. I aim especially to cover the periphery, because of the tendency of hemangioma to extend. In the deeper variety, after preliminary surface irradiation, and when there re-

mains a thick fibrous mass, it is inadvisable to use further surface irradiation (Cases I and V). I then insert 10-mg. radium needles (2.5 cm. in length with 0.4 mm. monel metal, or 2 cm. with 0.3 mm. iridioplatinum walls). These needles are usually placed 1 cm. apart and left in place for 48 hours. This gives about one-third the amount of radiation which I would give if the disease were malignant. When making surface application, I usually plan to give approximately 50 per cent of an erythema.

TREATMENT OF HEMANGIOMA

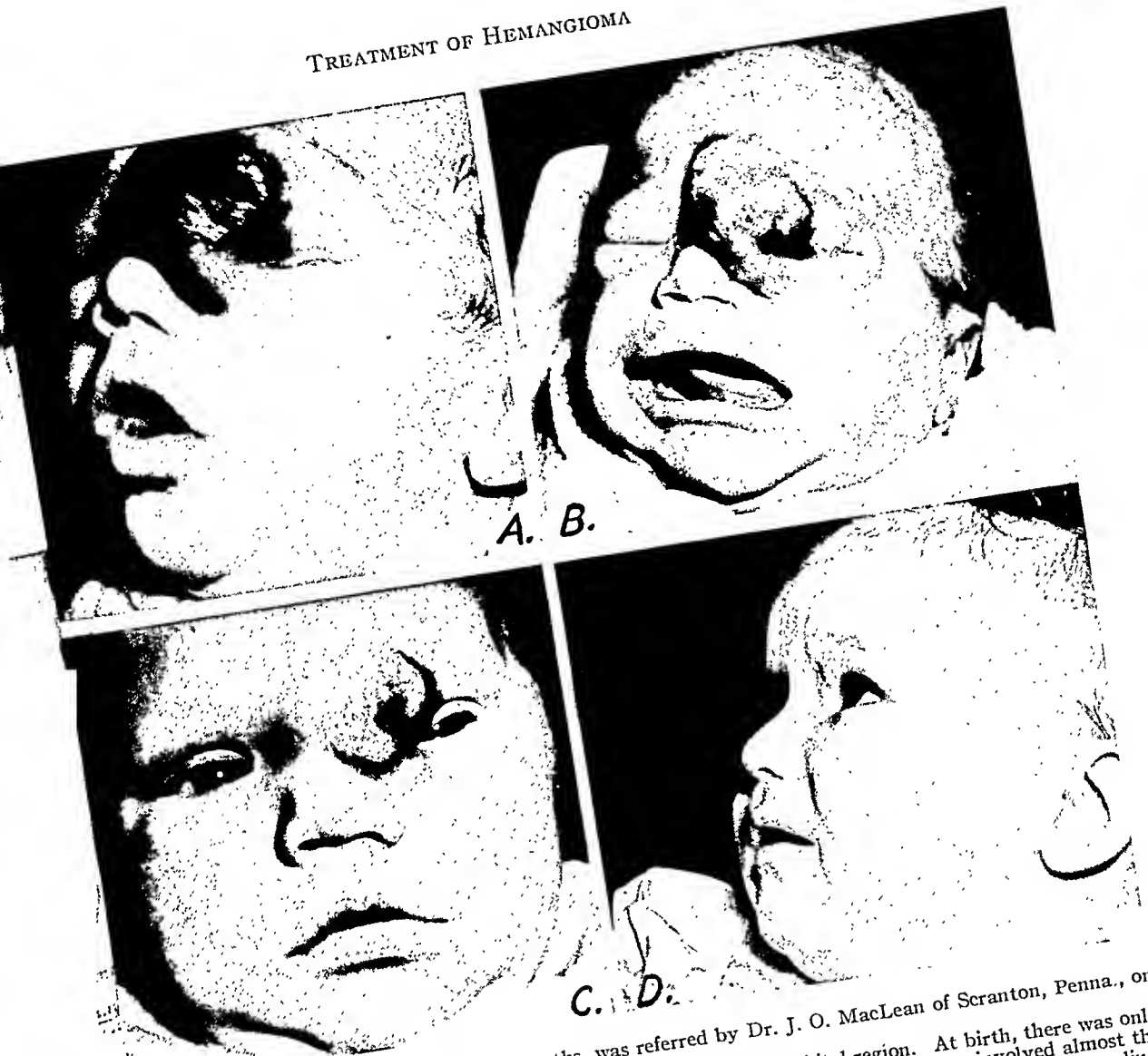


Fig. 5. Case V. C. H., female, age $3\frac{1}{2}$ months, was referred by Dr. J. O. MacLean of Scranton, Penna., on March 10, 1943. A, B, and C. Cavernous hemangioma involving the forehead and left orbital region. At birth, there was only a small, slightly elevated red mark present. At the beginning of the treatment, the disease involved almost the entire nose and most of the orbit. There was also a smaller lesion on the abdomen. Surface applications of radium were made as follows:

Date	Amount	Filter	Distance mm.	Time hr.	Region	Mg. hr.
5-43	14 × 10 mg.	1 mm. Pt + 2 mm. rubber + 2 mm. felt	5	2	Left eyelid, nose, left forehead	280
5-43	11 × 10 mg.	1 mm. Pt + 2 mm. rubber + 2 mm. felt	5	2	Left forehead	220
5-43	3 × 10 mg.	1 mm. Pt + 2 mm. rubber	3	2	Anterior abdomen	60
5-43	2 × 10 mg.	1 mm. Pt + 2 mm. rubber	3	2	Anterior abdomen	40
5-43	6 × 10 mg.	1 mm. Pt + 2 mm. rubber	3	$\frac{2}{3}$	Nose, left eyelid	...
5-43	1 × 10 mg.	Plaque 0.13 mm. Pt	...	$\frac{2}{3}$	Anterior abdomen	...
5-43	7 × 10 mg.	Plaque 0.3 mm. Pt	...	$2\frac{1}{2}$	Left upper eyelid (needles inserted)	...
5-43	4 × 10 mg.	Plaque 0.4 mm. Pt	...	$2\frac{1}{2}$	Left finger	...

In addition to this, x-ray treatment was given on May 13, July 8, and Oct. 7, 1943 (125 kv., 5 ma., $4\frac{1}{2}$ min., mm. aluminum filtration) for a total dose of 910 r. This was done to obtain a more homogeneous effect. D. All evidence of tumor tissue has disappeared. The left inner canthus has been crowded outward by the previous tumor. It may be advisable to repair this by a plastic operation at some future date.

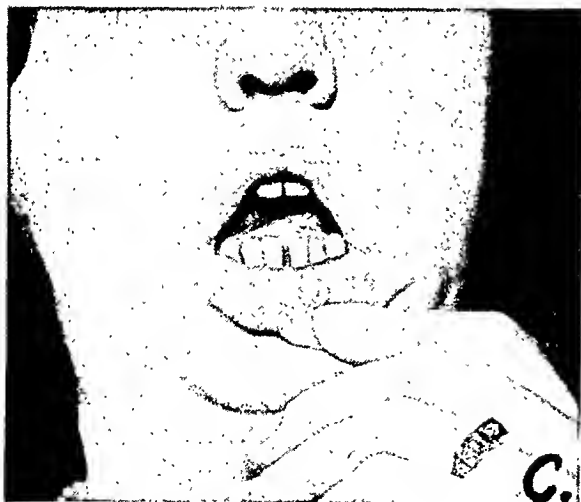


Fig. 6. Case VI. E. D., female, age 20, consulted me on July 26, 1926, on account of a cavernous hemangioma (A and B) approximately 2.5 cm. in diameter, on the inner surface of the right half of the lower lip. This case is reported because the statement has been made that cavernous hemangiomas need no treatment. This patient had received no treatment until she was ten years of age, when one of our leading surgeons

dose at each application. Perhaps doses repeated more often would be better, but this involves so much trouble and personal exposure in making up the plaques or applicators, that I aim to do much with each treatment as is possible. Sometimes I take apart and make over an applicator two or three times before it is just right. For example, in dealing with a cavernous hemangioma in a young girl involving all or part of the lower lip extending inside as well as outside, I must protect the upper lip, the nostrils, the gums, and the tooth germs, and apply the radium exactly where it is needed and keep it there. This requires patience, ingenuity, and conscientious work. It is done by cutting and bending one-sixteenth-inch lead to the exact size and shape necessary to hold the radium exactly where it is needed, with the lead toward the gums and tongue, fastening the radium to the applicator exactly as needed and covering the whole with vulcanized rubber. When radium is used on the eyelids, the greatest care must be taken to protect the eyebrows, the eyelashes, and the eyeball. The eyeball is protected by a special nickel-plated shield, under the lid, or by lead outside the lid, when the lid is not involved.

The distance of the radium from the surface should equal approximately the depth of the lesion. This must be modified and frequently the distance of the plaque must be increased merely to get uniform distribution of the radium from the unit. More uniform distribution can also be accomplished by using smaller units and placing them closer together. The time

cauterized the lesion, but it did not disappear. I applied a 100-mg. plaque of radium, made up with radium needles, each containing 10 mg., with monel metal 0.4 mm. in thickness. To this was applied enough rubber to give a distance of 2 mm. This was applied over the tumor on July 26, 1926, for two hours. A 60-mg. plaque, made up in a similar manner, was applied for three hours at a distance of 0.5 cm. on Oct. 25, 1926, and again on Nov. 26, 1926. This caused complete disappearance of the lesion with perfect result (C).

Other cavernous hemangiomas scattered over the body were treated by electrodesiccation with excellent results. None of these had been previously treated and they did not disappear without treatment.

application must vary with the distance one must know or calculate the value of each plaque. When it is necessary to make the application as brief as possible, I sometimes use units of 25 mg., with 1.0 mm. minimum filtration, as in treating the lip of a baby, because of the difficulty in keeping the radium exactly in place and because of the feeding problem.

As to the type of preparation of radium, one must adapt whatever is available. One cannot afford to buy radium in large quantities merely for the treatment of a hemangioma. I own 1,250 milligrams and have it divided into very flexible units, so as to make it available for many purposes. However, if one knows the principles governing radium effects and is familiar with the strength and biological effects of the preparations available, it is possible, with ingenuity, to adapt them to the needs of the particular case at hand. Without this knowledge, radium had better not be used. One must always be master of his own equipment, though it need not be exactly like that used by someone else if the principles of irradiation are followed.

As to the filtration or the quality of radiation from radium I believe to be important, it is my impression that the gamma rays give the best cosmetic results. Andrews says: "Only brass filtration (2 mm.) has been used during the past five years," and evidently considers the gamma rays best. In addition to the metal filter, I use one or more millimeters of rubber; if more distance is needed, felt or gauze of the proper thickness for the proper distance is useful. For small, very superficial lesions, I frequently use composition plaques such as are used in dermatology, with only 0.13 g. of Cu plus 1.0 mm. of rubber as filtration. A single application of thirty minutes up to an hour will usually be sufficient with the above filtration, with a plaque on a small lesion.

Time: The duration of the application will vary with the strength of the preparation, the filtration, and the distance. In general, I aim to give 50 per cent of an alpha dose. Care must be taken not

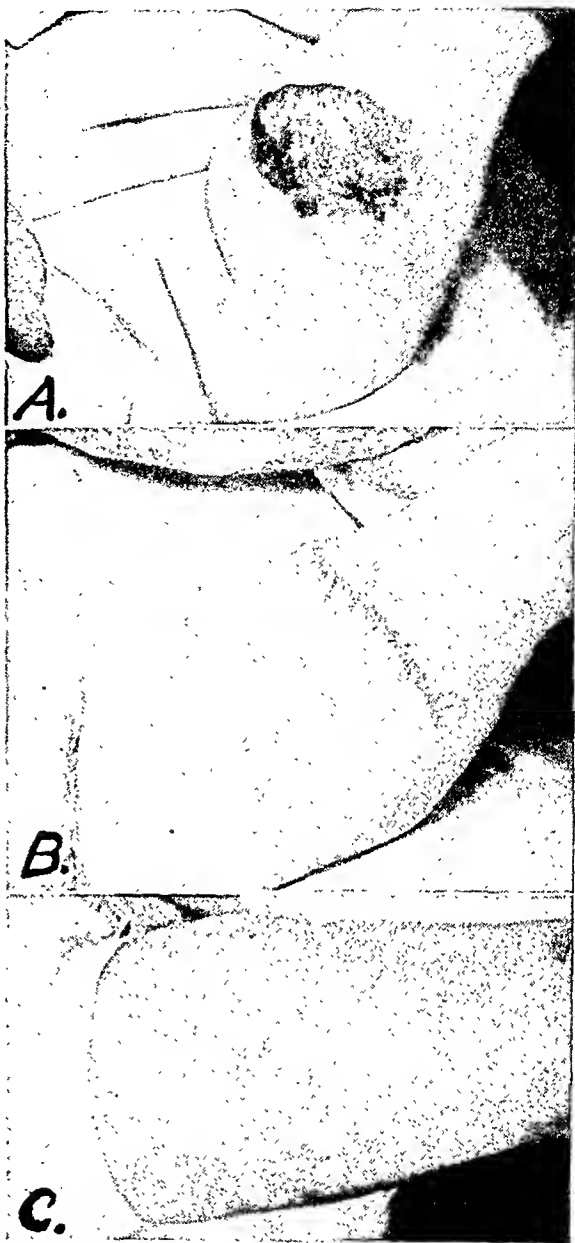


Fig. 7. Case VII. J. H., female, age $11\frac{1}{2}$ months, was referred by Dr. C. F. Stofflet of Pen Argyl, Penna. Cavernous hemangioma (A) approximately 5 cm. in diameter and elevated about 2 cm., occupying the inner side of the upper part of the left thigh. I hesitated to use radium because of the danger that might occur to the ovary, for with radium one cannot absolutely confine the radiation to the lesion. I hesitated to use x-ray treatment for fear of damaging the epiphyses of the left thigh. Therefore, under general anesthesia, I removed the entire tumor area by electro-surgery, then sutured the wound. Primary union was obtained (B). The patient was well June 7, 1939 (C). The microscopic diagnosis was "cavernous and telangiectatic hemangioma."

to overtreat. One should not produce ulceration or desquamation by any method



Fig. 8. Case VIII. D. B., female, age 18 months, was referred by Dr. Frank Scudder of Montclair, N. J. She had been treated elsewhere by surface radium applications, six treatments in all, in which 25 mg. were used (5 platinum tubes, with 0.5 mm. thickness). These applications were made at intervals of one week until 100 to 150 mg. hr. had been given. When I saw the patient, the surface was covered with scar tissue but the periphery was still red, and the tumor was elevated (A). It seemed to be firm and fibrous. I hesitated to use further radium because of the nearness of the lesion to the epiphyses. I referred the patient to Dr. Wm. Bates for surgical removal and an excellent result was obtained (B). This case illustrates the fact that one must adapt the treatment to the conditions present. I gave no treatment myself.

of treatment, for scarring is likely to follow. Scarring will result, too, if carbon dioxide snow has been used previous to the use of radium in the treatment of a thick cavernous hemangioma, and these scars persist after the lesion disappears from the effects of the radium. The interval between radiation treatments should usually be six weeks to three months, for it takes this length of time, as a rule, to get the full effects, and another treatment should not

be given until the full effect of the previous one has been obtained. The younger child, the more rapid will be the reaction with early treatment I believe that the extension of the lesion can be prevented.

RADIUM: DISADVANTAGES AND CONTRAINDICATIONS

(1) Radium must not be used for about or over the testicles or ovaries. In a case in which the lesion covered most of the scrotum, I destroyed the testicular tissue by electrodesiccation, obtaining a perfect result. (2) A small lesion on the scalp can better be destroyed by electrocoagulation, both because of the ease in confining the radiation to the lesion and keeping the radium in place, and because of the danger of destroying hair follicles over a wider area than by electrodesiccation. When the lesions on the scalp are large, one must run the risk of local alopecia in using radium applications. In one case which I shall demonstrate this danger does occur. (3) Radium application over the epiphyses of the fingers and toes may interfere with development of the bones. I have treated such lesions with radium because there seemed to be a better alternative. The time is too short to know whether damage has been done. Andrews had one case in which there was local interference with growth. The temporary results in cases have been satisfactory. In a case involving the entire forearm I used electrocoagulation followed by skin grafting. This method was chosen because I feared damage to the epiphyses. (4) Radium treatments usually require a number of visits and a year or more to accomplish satisfactory results. They are simpler and easier, and require less time to use electrosurgery and suturing of the wound (Fig. 7).

TREATMENT BY ELECTRODESICCATION

Electrodesiccation, i.e., the use of a small high-frequency spark through the lesion and not in contact with the lesion, is

der local anesthesia. It is indicated when the lesions are small, superficial, and situated where a slight scar is not objectionable. This is the same type of lesion which can be successfully treated by carbon dioxide snow or dermatological compositionium plaques. A small scar on the scalp or a superficial scar on the scrotum is not objectionable—or, at least, is a lesser evil—while a scar on the eyelids may cause con-

should be to destroy only the hemangioma, avoiding destruction of the deeper and healthy tissue, for the deeper the destruction, the more scarring will result. Superficial and incomplete destruction of a cavernous hemangioma will also cause scarring of the skin, even if the effect has not been deep enough actually to destroy the lesion. The result is an ugly white scar on the surface, with a bluish red tumor

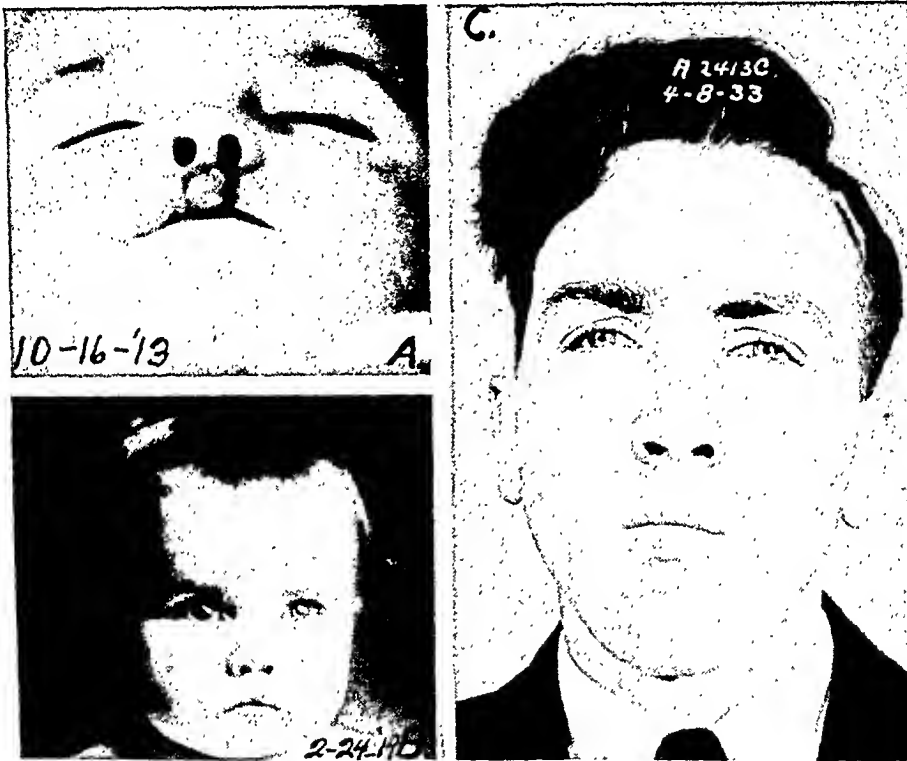


Fig. 9. Case IX. S. P., male, age 1 year, referred on Oct. 16, 1913, with a cavernous hemangioma approximately 1.5 cm., located in the center of the upper lip (A). This was destroyed by electrodesiccation under novocaine anesthesia, showing a perfect result after four months (B). This was maintained twenty years later (C).

action. I have found electrodesiccation especially useful in the destruction of the *irregular and warty birthmarks*, particularly on the scalp (Fig. 11). When electrodesiccation is used on the scalp, one should separate the skin from the periosteum so that the bone will not be damaged by the spark. Otherwise, necrosis of the external table and sequestration will follow. This separation of the lesion from the scalp is easily accomplished by the injection of novocaine *under* and around the lesion.

In the use of electrodesiccation, the aim

underneath. Skill and good judgment are essential in this method of destruction.

ELECTROSURGERY

Electrosurgery in the treatment of cavernous hemangioma consists in the use of the high-frequency bipolar cutting current. The current should be adjusted so as to cut but not to produce a flame. The wound can then be sutured. So far, in the cases in which I have used this method, I have obtained primary union, no infection, and quite satisfactory results. Electrosurgery

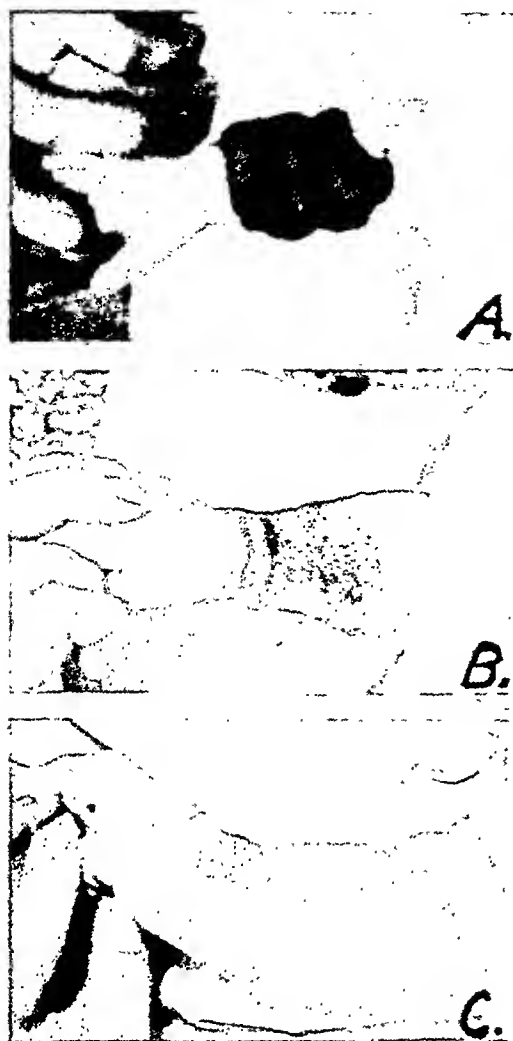


Fig. 10. Case X. M. Y., female, age 2 months, was referred by Dr. J. M. Schildkrant of Trenton, N. J., on Aug. 16, 1932, with a cavernous hemangioma involving the entire right forearm (A). Because of the age of the patient and possible danger to the epiphyses, this was not treated by irradiation. Instead I removed the entire tumor by electrocoagulation. The area was dressed until all necrotic tissue had been thrown off and healthy granulation tissue had formed. Then, on Oct. 5, 1932, at my request, Dr. Wm. Bates did a skin grafting operation with a perfect result, as shown in C, Nov. 9, 1932.

is indicated when the lesion is rather large; when it is supported by a good layer of subcutaneous tissue; when the surrounding tissue is sufficiently movable to allow suturing; when time is of importance; and when irradiation may do damage to epiphyses or to the gonads (Fig. 7).

TYPES OF HEMANGIOMA

The above discussion applies particularly to the cavernous and strawberry-

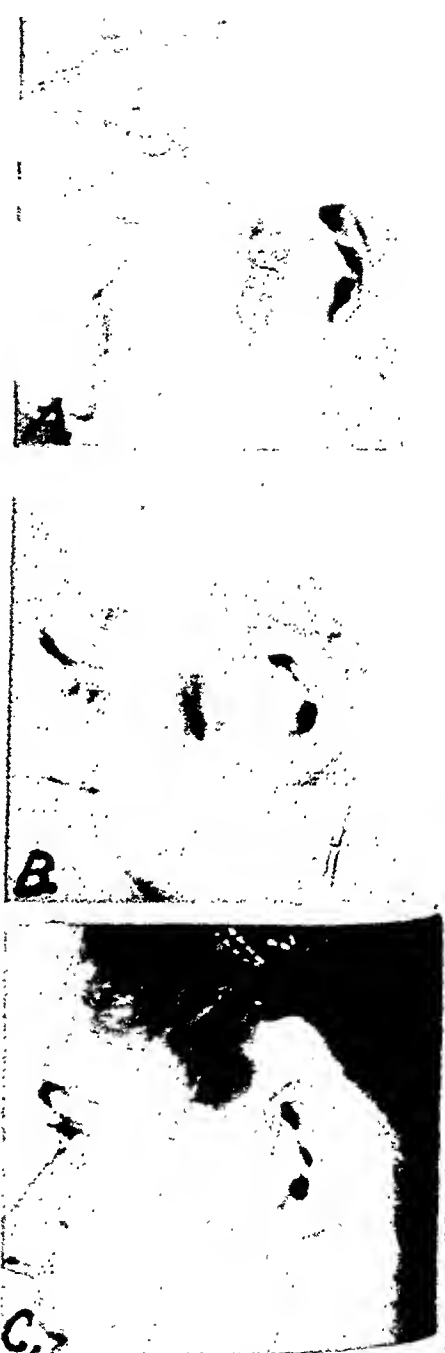


Fig. 11. Case XI. N. M., female, 5 years, was referred by Dr. Woodward of Pleasantville, N. J., and Dr. Chas. B. Smith of Atlantic City, N. J., on Oct. 5, 1932, on account of a warty birthmark (A) located on the left ear. It was present at birth but increased during the past five years. The patient had had some previous x-ray and rubber treatment, with no improvement. The lesion involved an area, approximately 8 X 6 mm., extending from the parotid region upward over the ear.

This case is reported because it represents a type that I believe should not be treated by irradiation. I destroyed the entire lesion under anesthesia by electrodesiccation, obtaining a perfect end-result, as shown in C, Jan. 1937.

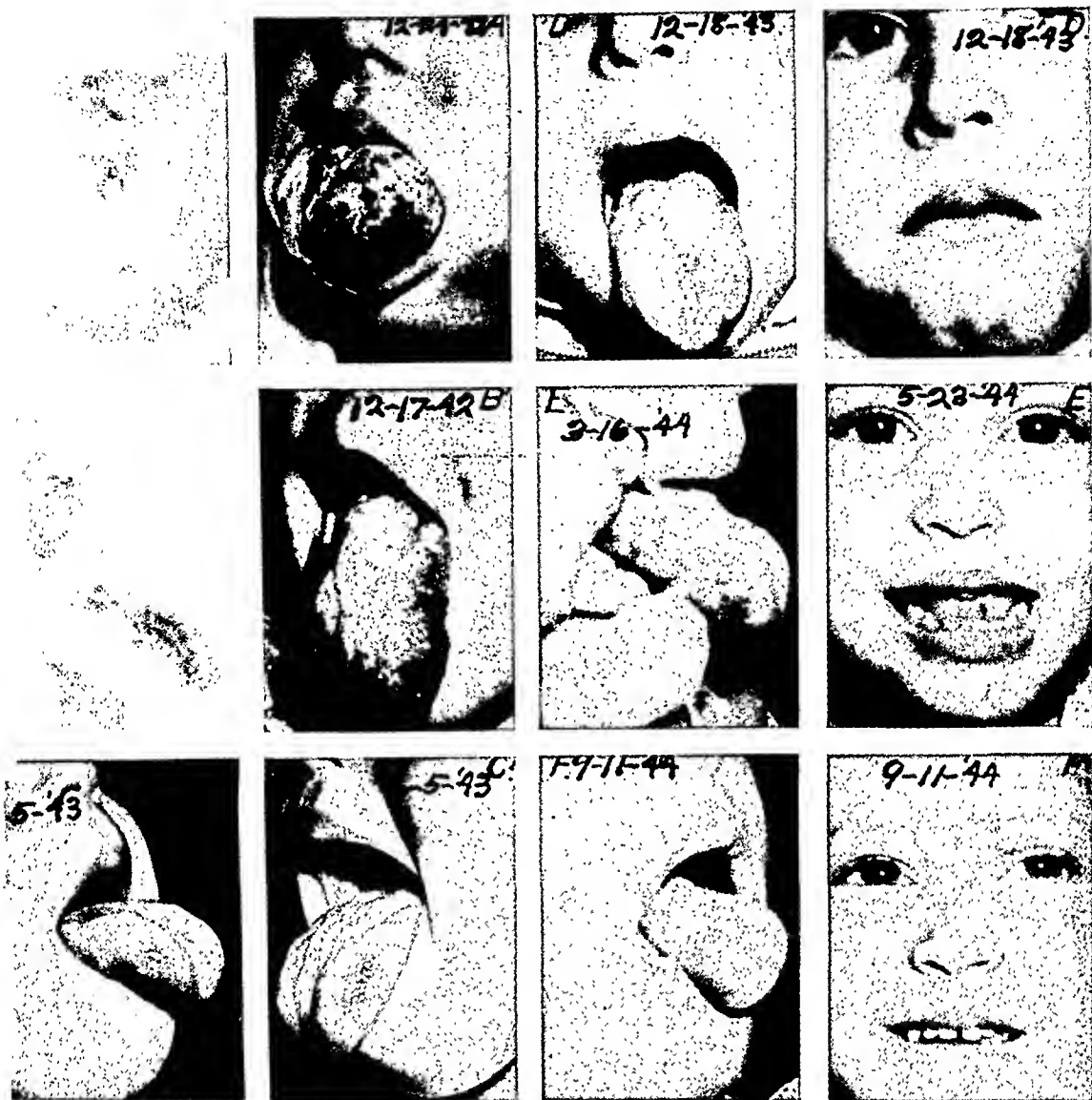


Fig. 12. Case XII. B. S., female, age 32 months, was referred by Dr. Otto Goldstein, Dec. 17, 1942. She had a hemangioma involving the entire tongue, particularly the left side (A, A', B, B'). The tongue was approximately four times normal thickness, and the patient was unable to retract it into the mouth. The tumor contained considerable fibrous tissue. A portion of this warty growth had been removed surgically by Dr. Henry Miller on Aug. 29, 1941, and the wound in the tongue was sutured. This operation was followed by much swelling. Surface applications of radium had been made by Dr. B. P. Widmann, and "contact" roentgen therapy under general anesthesia had been given by Dr. Eugene Pendergrass in January 1942. The tongue became swollen and red after each of these contact treatments, but the tumor tissue had undergone little change. After conferring with the above-named physicians, I decided, in view of all the circumstances, that it was best to introduce radium needles into the tumor. This was done under Venethene anesthesia. On Dec. 18, 1942, thirteen 10-mg. radium needles in 0.4 mm. monel metal were introduced into the left side of the tongue for three hours. On April 1, 1943, thirteen of these needles were inserted for a period of two hours, making a total of 680 g. hr. on the left side of the tongue. Marked improvement followed (C and C'), with the left side becoming almost normal (June 5, 1943), as a result of the needling described above. Further improvement is shown in D' and D' (Dec. 18, 1943) as a result of the treatment described above, plus a roentgen dose of 250 r (125 kv., 5 ma., 6 min., 30 cm. distance, 2 mm. aluminum filtration) on Nov. 12, 1943. This roentgen treatment was repeated on the date of the photograph, Dec. 18. The left side of the tongue is now nearly normal, and can be completely retracted into the mouth. Some increase in the hemangiomatous condition of the right side of the tongue and floor of the mouth was apparent March 16, 1944 (E). On this date, under general anesthesia, the diseased tissue was destroyed by electrodesiccation. Eight 10-mg. radium needles were then inserted into the right side of the tongue for two and a half hours. The tongue was fully retracted and practically normal on May 23, 1944 (E'). At that date, the lower teeth had been pressed forward by the previous enlargement of the tongue, so that they projected beyond the upper teeth. Under repeated pressure during the next four months, these teeth have receded almost normally. The right side of the tongue is now practically normal (F and F'), as are the teeth and mouth.

mark hemangiomas or birthmarks affecting the surface of the body. Electrodesiccation is also applicable to nevi, both the pigmented and the hairy types. Radium and x-rays are not satisfactory in the treatment of the thickened, warty, and hairy types (Fig. 11). I have had no experience in the treatment of *hemangioma of bone*, though it seems to me that high-voltage roentgen therapy would be useful. Good results have been reported in hemangioma of the spine by Ghormley, Stehr, Ferber, Schlezinger, and Thomas. Since surgery is serious, but the only alternative, it would seem advisable to try irradiation in all such cases, and allow enough time to see results.

The essential factors used in treating the illustrative cases are given briefly in the legends.

SUMMARY AND CONCLUSIONS

1. Hemangioma is a disfiguring and distressing blemish in a child. The cavernous and strawberry types respond satisfactorily in nearly all cases to irradiation therapy and therefore should be treated as early as is practicable. I have found no series of cases reported in the literature in which the lesions have disappeared spontaneously. One finds only an occasional statement that this may occur. I have never seen it. Therefore, one should not wait for spontaneous cures.

2. The portwine type of hemangioma has not responded to irradiation. At present, it seems best to cover this type with cosmetic.

3. The type of irradiation as reported in the literature and used with success has varied from 50-kv. contact roentgen therapy to 200-kv. with filtration through 0.5 mm. copper, and to gamma radiation from radium. The gamma radiation seems to give the most uniformly good cosmetic results, and I prefer it.

4. Good results have been reported

with carbon dioxide snow and injection. have used electrosurgery and electrodesiccation with good results in selected cases.

5. Good results have been reported following high-voltage irradiation of hemangioma of the vertebrae.

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The Value of Stereoscopy in Mass Radiography of the Chest¹

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THE DIAGNOSIS of disease by general radiographic methods involves two fundamental processes. The first concerns the detection of an abnormal condition and constitutes that portion of the examination in which the film is carefully scanned in an effort to discover unusual roentgen patterns. The second process concerns the identification of disease and concerns that part of the examination in which the abnormal patterns, having been found, are scrutinized and their characteristics evaluated in order to establish the nature of the lesion.

In these two processes, stereoscopy may be of considerable assistance. This is particularly so in the identification phase, where the localization and improved visualization of the roentgen changes afforded by stereoscopy are useful in reaching a pathological diagnosis. It is not surprising then that stereoscopy has become a well established procedure in general radiology.

The situation regarding stereoscopy in mass radiography of the chest, however, is much less well defined. Here the emphasis is almost solely on the detection of disease, with the identification process being reserved until a study has been made of full-size 14 × 17-inch films in one or more projections. This fact obviously reduces to some extent the need for the stereoscopic technique in this type of examination.

Stereoscopy will exhibit its greatest usefulness in mass radiography in those cases in which an existing lesion is so small that it may be hidden by a rib or clavicle and therefore overlooked. Opinions regarding the incidence of such cases among the general population vary between rather wide limits, some radiologists believing that a sizable proportion of minimal tuberculous lesions will be undetected unless

stereoscopy is employed in the small film examination and others being equally certain that only a few will be overlooked.

In an effort to resolve this difference of opinion, over 4,000 stereoscopic 4 × 10-inch films of the chest were recently examined by the writers with a view to finding the number of minimal tuberculous lesions that might be overlooked if single instead of stereoscopic films are made in mass chest surveys. This group of films was obtained from several surveys to which the writers had access and included, by deliberate selection, a large number of pathological lesions. Minimal tuberculosis was the process chosen for study not only because of its current significance in case finding but because its localized nature makes it likely that stereoscopy would assist in its visualization more than in that of other lesions. There are, for example, other processes, such as the pneumoconioses, that are difficult to detect radiographically, but these lesions are frequently generalized in extent and therefore are not usually clarified by multiple views.

Within the group of films studied, 609 presented evidence of minimal tuberculosis. Among these, slightly more than a third exhibited small, poorly defined opacities with irregular borders characteristic of so-called exudative tuberculosis and therefore considered worthy of further clinical investigation. The remainder indicated only such changes as fibrotic strands and pulmonary scars and were deemed of little significance. This ratio of significant to non-significant cases is in close agreement with the writers' experience in mass case-finding work throughout the United States. The group, therefore, probably constitutes a representative sample of minimal tuberculous disease in the general population.

¹ From the Radiology Section, Tuberculosis Control Division, U. S. Public Health Service. Accepted for publication in July 1945.

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Within the group of potentially significant films, only 7 were discovered in which the lesions were seen in one of the stereoscopic views and not in the other. This represents 1.1 per cent of the total number of films exhibiting changes of minimal tuberculosis. In 27 other films, or 4.4 per cent of the total, the lesions were seen to better advantage on one of the stereoscopic pair but were visualized sufficiently well on both views to permit detection regardless of which was chosen for study. As might be expected, the cause of the poorer visualization in many cases was the superimposition of the lesions on rib structures. In other instances variation in projection accounted for the differences observed. In all cases, however, it was more the duplicity of view than the fact that the films were made stereoscopically that seemed to improve perception.

In regard to the films in which one of the stereoscopic pair failed to record the lesion, it is reasonable to say that not all 7 cases would be overlooked in a mass radiographic chest survey if only single films were made, since there is obviously an equal chance that the better of the two views would be obtained. It therefore follows that only 0.6 per cent of cases of minimal tuberculosis (*i.e.*, one-half of 1.1 per cent) are likely to be overlooked if single instead of stereoscopic films are made routinely in mass radiography.

Mass chest surveys conducted by the U. S. Public Health Service and associated groups have shown that approximately 1 per cent of the population has x-ray evidence of minimal tuberculosis. One may therefore expect stereoscopy to be of assistance in the detection of this disease in only 6 per 100,000 individuals examined. This certainly must be considered an insignificant number, especially in view of the fact that the personal error which a physician exhibits when reading chest films of all types (*i.e.*, 14 × 17-inch celluloid, 14 × 17-inch paper, 4 × 10-inch, and 35-mm.

films) is, as recently shown by a carefully controlled study (1), many times greater.

Furthermore, since the cost of making stereoscopic films is almost double that of making single films, it is evident that the number of cases of tuberculosis that may be discovered for each case-finding dollar that is spent will be approximately twice as great when single films are made. For example, if 200,000 persons are examined by single films, statistical data (2) indicate that 3,000 cases of tuberculosis of all types (minimal, moderately advanced, and highly advanced) will be discovered. If stereoscopy were employed, with the same fund available for the study, only 100,000 persons could be examined, with the resultant discovery of 1,500 cases of tuberculosis plus 6 additional cases which would be detected because of the use of stereoscopy. From a public health standpoint, therefore, the choice of procedures is overwhelmingly in favor of the single film method.

From the foregoing it is clear that stereoscopy adds little to the diagnostic accuracy of mass radiography of the chest. This applies to case finding in hospitals as well as in industry. It is recognized that many radiologists and chest specialists have a strong personal preference for stereoscopy. However, it must be constantly borne in mind that such a preference is based purely on subjective factors. It appears that if the single film technic were used for the detection of disease, and stereoscopy were confined to the identification of lesions discovered by mass radiography, maximum benefits would be derived from the case-finding procedures which are available today.

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Comparison of Two Levels of Roentgen and Neutron Irradiation of Normal and Lymphomatous Mice, Using Radiophosphorus as an Indicator of Cellular Activity¹

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RADIOPHOSPHORUS² has been used as a tracer in studies of the phosphorus change of normal and lymphomatous tissues of mice (1, 2). It has been shown that the P³² uptake by neoplastic tissues is the result of their mitotic activity (3, 4). Amounts of radiation causing a depression of tissue metabolism should also reduce its

- II. Normal Mice
Group D: 3 mice
(normal control).....No irradiation
Group E: 2 mice.....65 n neutrons

Twenty-four hours after groups A, B, and E had been irradiated, all five groups were given P³² (0.25 c.c. of an isotonic solution of disodium phosphate containing 4.3 microcuries of P³² at pH 7 subcutaneously).

TABLE I: PERCENTAGE OF P³² RETENTION PER GRAM OF TISSUE 24 HOURS AFTER P³² INJECTION AND 48 HOURS AFTER NEUTRON OR ROENTGEN IRRADIATION,* FOR LYMPHOMATOUS AND NORMAL MICE. SERIES I

Tissue	Group A Lymphoma 400 r x-ray (5 mice)		Group B Lymphoma 65 n neutrons (3 mice)		Group C Lymphoma Control (6 mice)	Group D Normal Control (3 mice)	Group E Normal 65 n neutrons (2 mice)
	% Retained	% of Control	% Retained	% of Control	% Retained	% Retained	% Retained
Tumor	2.14	89	1.17	49	2.40		
Liver	2.27	95	2.30	96	2.40	2.88	2.99
Spleen	3.0	73	2.84	69	4.10	3.20	2.78
Muscle	1.63	107	1.49	98	1.52	2.0	2.05
Bone	2.33	89	2.64	100	2.64	5.70	5.45

* Whole body irradiation.

phosphorus accumulation. In the investigation to be reported here, P³² was used in order to compare the effects of neutron and roentgen irradiation upon normal and lymphomatous tissues (5). The measurements of neutron and roentgen radiation were made by Dr. Paul Aebersold.

Two series of experiments were performed. In Series I, 19 Strong "A" female mice were used. Of these, 14 were inoculated with lymphoma subcutaneously on one side only. Twenty days later the mice were divided into five groups and treated as follows:

- I. Lymphomatous Mice
Group A: 5 mice.....400 r x-ray (whole body)
Group B: 3 mice.....65 n neutrons (whole body)
Group C: 6 mice
(lymphoma control)...No irradiation

Forty-eight hours after irradiation, the mice were killed. The tissues listed in Table I were ashed in an electric muffle furnace. They were assayed for activity with an electroscope.

In Series II of this experiment, 17 Strong "A" female mice were inoculated with lymphoma subcutaneously on one side only. Twenty-one days later, they were divided into three groups and treated as follows:

- | Lymphomatous
Mice | Irradiation
Administered |
|--|-----------------------------|
| Group I: 6 mice (lymphoma controls)..... | None |
| Group II: 6 mice..... | 300 r x-ray (whole body) |
| Group III: 5 mice..... | 50 n neutrons (whole body) |

Eight hours after irradiation, these mice were given P³² (0.25 c.c. of an isotonic solu-

¹ Accepted for publication in June 1945. This work was supported by the Columbia Fund for Medical Physics of the Columbia Foundation.
² Hereafter called P³².

TABLE II: AVERAGE WET WEIGHTS OF TISSUES (IN GRAMS) OF LYMPHOMATOUS AND NORMAL ANIMALS 48 HOURS AFTER ROENTGEN AND NEUTRON IRRADIATION. SERIES I

Tissue	Group A Lymphoma 400 r x-ray (5 mice)	Group B Lymphoma 65 n neutrons (3 mice)	Group C Lymphoma Control (6 mice)	Group D Normal Control (3 mice)	Group E Normal Control 65 n neutrons (2 mice)
Tumor	1.40	1.07	3.62		
Liver	1.60	1.70	1.90	1.10	1.10
Spleen	0.26	0.17	0.59	0.22	0.14

TABLE III: BODY WEIGHTS (IN GRAMS) OF LYMPHOMATOUS MICE IMMEDIATELY BEFORE IRRADIATION AND THIRTY-SIX HOURS LATER. SERIES II

Control Animals Lymphoma Only		Lymphoma 300 r x-ray		Lymphoma 50 n neutrons	
Before	After	Before	After	Before	After
24.7	24.0	24.7	20.4	20.7	18.2
26.3	25.0	23.7	21.0	23.4	21.6
26.3	25.0	27.4	23.4	21.1	18.0
24.4	24.0	22.0	20.2	20.0	18.0
20.0	18.3	25.1	22.0	23.6	21.3
22.3	22.0	23.1	20.0		
Ave.	24.0	23.1	24.3	21.2	21.8
					19.4

Series II the depression of phosphorus metabolism was greater than in Series I although the dosages were of the same order (see Tables I and IV). This difference may be due to the difference in time intervals chosen.

Neutrons appear to be roughly six times as effective as roentgen rays in reducing the phosphorus uptake of the lymphoma. Although the tumors, before irradiation, in comparative groups, were essentially the

TABLE IV: PERCENTAGE OF ADMINISTERED P^{32} PER GRAM 24 HOURS AFTER INJECTION AND 32 HOURS AFTER NEUTRON OR ROENTGEN IRRADIATION. * SERIES II

Group I: Control mice received lymphoma subcutaneously 21 days prior to irradiation of Groups II and III.								
	Mouse A	Mouse B	Mouse C	Mouse D	Mouse E	Mouse F	Average, %	Std. Error
Tumor	4.5	3.5	3.6	3.9	3.9	3.9	3.88	0.38
Lymph Nodes	4.8	4.7	4.6	4.2	5.4	5.4	4.67	0.45
Spleen	7.0	4.0	6.0	5.7	6.5	...	5.89	0.89
Liver	4.9	2.6	3.8	3.3	4.2	4.9	3.65	0.35
Group II: 300 r x-rays plus lymphoma subcutaneously 21 days prior to irradiation.								
	Mouse A	Mouse B	Mouse C	Mouse D	Mouse E	Mouse F	Average, %	Std. Error
Tumor	2.0	2.4	1.1	2.1	1.3	2.2	1.85	0.47
Lymph Nodes	2.7	4.5	2.1	3.3	2.1	3.2	2.98	0.61
Spleen	2.3	3.2	5.2	3.2	4.1	...	3.60	0.61
Liver	2.9	3.8	3.4	3.7	3.1	3.2	3.35	0.48
Group III: 50 n neutrons plus lymphoma subcutaneously 21 days prior to irradiation.								
	Mouse A	Mouse B	Mouse C	Mouse D	Mouse E		Average, %	Std. Error
Tumor	1.9	2.3	2.0	2.6	1.5		2.06	0.31
Lymph Nodes	4.0	4.0	4.0	5.0	4.0		4.20	0.52
Spleen	5.5	2.3	4.4	4.0	5.8		4.40	0.75
Liver	3.2	3.1	3.6	3.8	3.9		3.52	0.31

* Whole body radiation.

tion of disodium phosphate at pH 7 subcutaneously, containing 7.0 microcuries P^{32}). Thirty-two hours after irradiation, the mice were killed. The tissues listed in Table IV were assayed for activity in the same manner as in Series I.

The experiments described above indicate that the accumulation of phosphorus by tumor tissue (lymphoma) is depressed by neutron or roentgen irradiation. In

same in size, neutrons possibly caused greater regression of lymphoma than roentgen rays (see Tables II and V).

Liver, spleen, and lymph nodes became infiltrated with the lymphoma used in these studies (5). The data show that the phosphorus uptake of these tissues is depressed (see Tables I and IV). Inhibition of growth of the infiltrating lymphoma cells is also suggested by a reduction in the

TABLE V: AVERAGE WET WEIGHTS (IN GRAMS) OF TISSUES OF LYMPHOMATOUS MICE FOLLOWING NEUTRON AND ROENTGEN IRRADIATION. SERIES II.

Tissue	Control	300 r x-ray	50 n neutrons
tumor	0.748	0.459	0.264
lymph node	0.253	0.084	0.081
	both sides	one side	one side
spleen	0.609	0.203	0.217
liver	1.876	1.798	1.591

et weights of these tissues (see Tables II and V). The effect of irradiation upon the total body weights of the mice used in Series II is given in Table III. Although some weight was lost, it was relatively much less than that observed in the irradiated tissues. No definite effect upon the phosphorus metabolism of normal mice was observed when 65 n were given in Series I.

SUMMARY

Neutrons and roentgen rays depress the phosphorus uptake of lymphomatous tis-

suess in mice as measured by radiophosphorus. By the use of this technic, another method is available for the study of the effects of various radiations on normal and neoplastic tissues.

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Some Observations on X-Ray Treatment Cones¹

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IN RECENT years, considerable attention has been given to the matter of providing the radiotherapist with more reliable high-tension generating equipment and x-ray tubes, more accurate physical measurements of the x-ray output, and more trustworthy evaluations of skin dose and depth dose data. With respect to treatment cones, however, it would appear that some improvement is still necessary. Manufacturers have made available a large variety of cones and applicators which in many cases are being used in conjunction with x-ray equipment without full realization of their individual limitations. In particular, the practice of supplying accessories which attempt to provide for all types of therapy (superficial, deep, and cavity) with the one high-voltage therapy unit has resulted in the production of some treatment cones which do not conform to sound physical principles. This report is based on experience gained during the routine calibration of all types of x-ray equipment in Australia. With many of the points raised the radiological physicist is already familiar, but it is felt that emphasis should be laid on the need for more careful design of treatment cones.

Quimby and Marinelli (1), Jacobson (2), and Silverstone and Wolf (3) have all shown the necessity for the photographic examination of the field of a treatment cone. During the initial calibrations of x-ray equipment by this laboratory a routine check by photographic and ionization means is made of the fields produced by individual cones, and it is our impression that little has been done in recent years to improve the general design of cones.

TYPES OF TREATMENT CONES

In general, treatment cones are provided for attachment either to a master cone or

directly to the tube housing. Cones are used for the following reasons:

- (1) To maintain a given focal-to-skin distance.
- (2) To limit the x-ray beam to a particular area which it is desired to irradiate.
- (3) To aid in the directioning of the x-ray beam.
- (4) To provide compression when deep-seated lesions are being irradiated. If by the use of compression, the distance between the skin and the lesion can be diminished, an appreciably higher dose can be delivered to the lesion for any given value of the skin dose.

Cones can be conveniently classified into two essentially different types, depending on the method by which the area is defined at the cone surface. In the first type (Fig. 1, A) the cone has a large upper aperture and the walls are constructed of radiopaque material (usually lead); this can be called the side-shielded cone. Such cones are supplied with some deep-therapy equipment but are much more generally used in association with superficial contact therapy apparatus. The second type (Fig. 1, B) has a radiopaque diaphragm at the top with an aperture of the correct dimensions to define the beam at the exit surface of the cone. The walls are constructed of some light material, their only requirement being sufficient rigidity to support the exit surface at a definite distance. This type can be called the top-diaphragm cone. Contrary to the opinion of Silverstone and Wolf that the most satisfactory cones are those in which the field is defined at the skin surface, we have been of the opinion that the top-diaphragm cone is most satisfactory, and only the latter type is now used with deep-therapy equipment in Australia.

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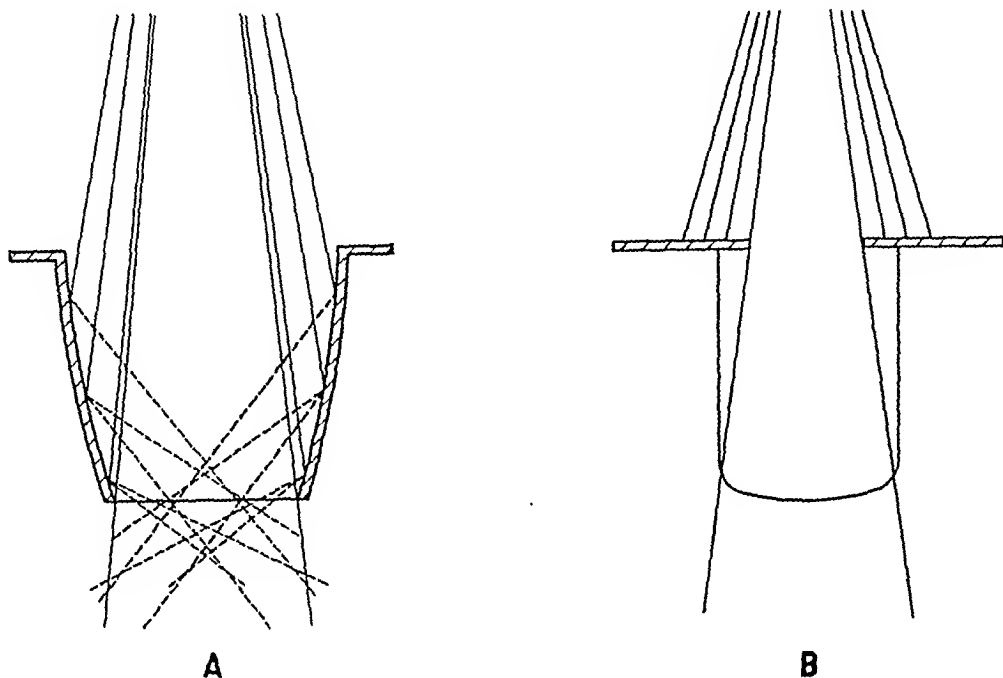


Fig. 1. Typical construction of (A) side-shielded cone and (B) top-diaphragm cone. The radiopaque material limiting the beam is indicated by hatching. The direct radiation is indicated by continuous lines, the scattered radiation by broken lines.

We have, however, recently compared again the two types of cone. Reference to Figure 1, A, will show that the radiation reaching the skin from the side-shielded cone consists of (1) radiation reaching the skin directly from the focal spot (it is this radiation alone which is transmitted by the top-diaphragm cone) and (2) radiation reaching the skin after scattering from the lining of the wall of the cone.

To study the effect of this second component, the limiting diaphragms were removed from two standard treatment cones with areas of 10×10 cm. and 4×4 cm., respectively, and the walls of the cones lined with lead to define the area of the exit surface. Ionization measurements showed that the radiation reaching the skin after scattering from the walls of the cone was approximately 12 per cent in the case of the 10×10 -cm. cone and appreciably more with the 4×4 -cm. cone. This is in general agreement with the results of Silverstone and Wolf, and of Williams (4). By testing the validity of the inverse-square law, however (see Table

I), it was shown that this scattered radiation traversed the face of the cone at such angles that the majority of it was outside

TABLE I: TEST OF VALIDITY OF INVERSE-SQUARE LAW WITH DIFFERENT CONES

F.S.D. d cm.	Top-Diaphragm Cone		Side-Shielded Cone	
	Free Air Output r/min.(I)	Id^2	Free Air Output r/min.(I)	Id^2
51.5	35.2	934×10^2	38.1	$1,011 \times 10^2$
52	...	...	36.6	990×10^2
53	33.1	930×10^2	33.7	946×10^2
55	30.9	935×10^2	30.8	930×10^2
58	...	...	27.6	928×10^2
60	25.9	933×10^2	26.05	938×10^2
65	...	...	22.05	932×10^2
70	19.1	935×10^2	19.1	935×10^2

the direct beam after traveling 3 cm. below the face of the cone. The presence of this additional radiation, although at first sight appearing to have advantages, actually introduces two difficulties. Since it is impossible to place the ionization chamber in the plane of the face of the cone, the evaluation of the x-ray dosage in that plane is deduced from measurements taken at known distances below the

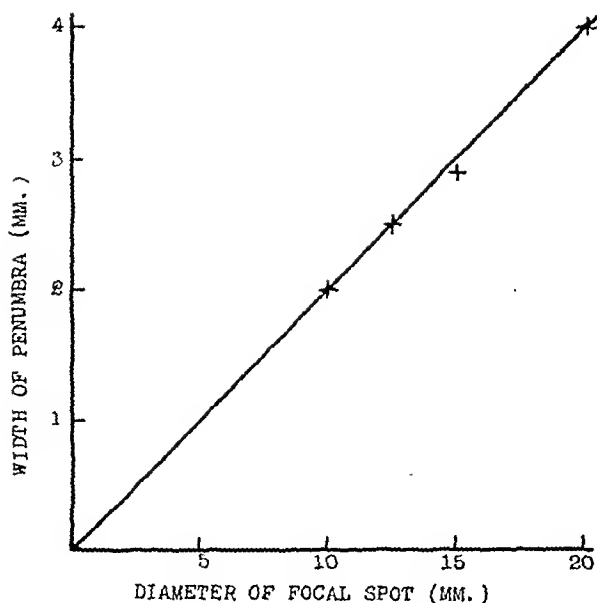


Fig. 2. Variation of width of penumbra with diameter of focal spot for a focal-skin distance of 50 cm., a diaphragm-skin distance of 15 cm., and a treatment port of 10×10 cm. Geometrical consideration shows that the width of the penumbra will be different at different edges of the field. That shown (for the edge adjacent to the cathode) has the maximum value.

partures from the law occur. A much more serious difficulty arises, however, in the actual treatment of a deep-seated lesion, since the scattered radiation then only adds an undesirable dose to the skin and superficial tissues and leads to a decrease in the depth dose for any given value of the skin dose. Moreover, it can be shown that the scattered component is definitely softer than the direct radiation and this fact again leads to additional dosage of the superficial tissues. The proportion of the scattered component will, of course, depend upon the geometrical factors of the cone system. It may be that the soft component is a reason for the lack of agreement between published backscatter and depth dose data where workers have used cones of different types.

One criticism of the top-diaphragm cone has been the decrease of dosage toward the edge of the cone due to penumbral images.

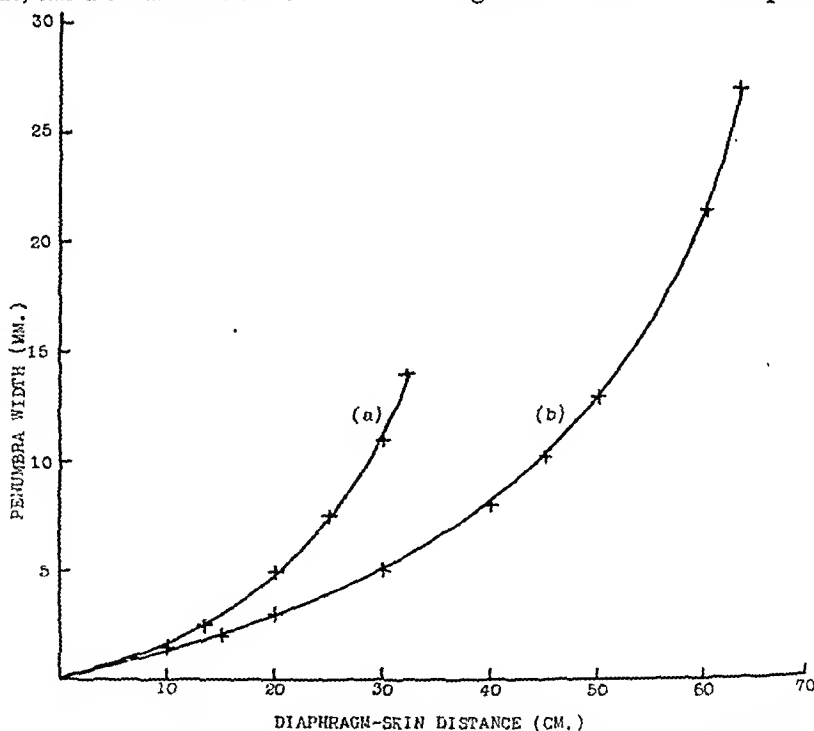


Fig. 3. Variation of width of penumbra for a 10×10 -cm. field with variation in the position of the defining diaphragm relative to the skin: (a) for a focal-skin distance of 50 cm.; (b) for a focal-skin distance of 80 cm.

plane. In cases where the inverse-square law is obeyed (as with the top-diaphragm cone) this evaluation can be made with much greater accuracy than where de-

In the photographic examinations, it has not been our experience to find any extensive penumbra, but the magnitude of the penumbra is of course determined by the

size of the focal spot, and the relative distances from it of the cone face and the defining diaphragm. Figure 2 shows the variation of the width of the penumbra with variation in the diameter of the focal spot when the diaphragm-skin distance is 5 cm. for a focal-skin distance of 50 cm. and a treatment cone of 10×10 cm. In Figure 3 the variation of the width of the penumbra with variation in the position of the defining diaphragm relative to the

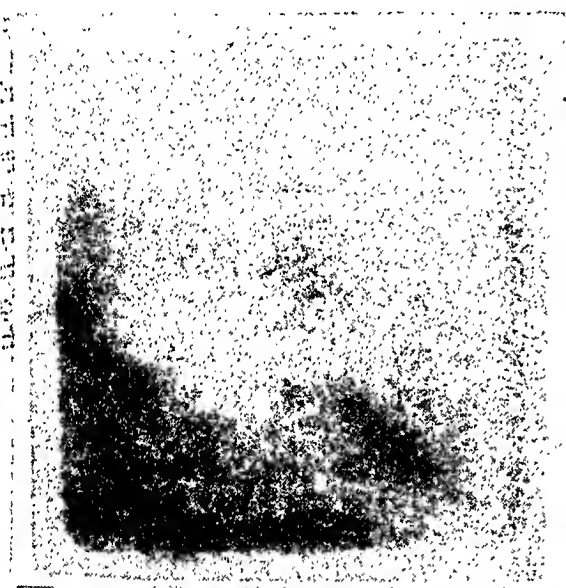


Fig. 4. Field produced by a commercial top-diaphragm cone at 50 cm. The reduced intensity at the edges is due to absorption in the end of the cone.

skin for the same treatment cone is illustrated. It is evident that the width of the penumbra is reduced by reducing the distance between the defining diaphragm and the skin and it would be advantageous to use as short a treatment cone as possible consistent with ease and accuracy in adjusting the cone to the patient. Further, it would appear more satisfactory to use a longer master cone when transferring from 50 to 80 cm. focal-skin distance than to place longer treatment cones on the one master cone. In equipment fitted with an intensimeter, this may necessitate a built-in ionization chamber in each master cone, but with these placed at different distances from the focal spot a check against error in cone selection would be provided.



Fig. 5. Field produced by a commercial cone in which metal fittings of the ionization chamber in the master cone limit the beam. The area of the expected field is shown by the lines.

It can be seen that in any case the area of the penumbra is small compared with the area of the field. It is possible, however, that particular commercial cones produce a field in which it appears that an extensive penumbra is present. The field of a 10×10 -cm. top-diaphragm cone of this type, with a focal-skin distance of 50 cm., is shown in Figure 4. The reduced intensity at the edges in this case is not due to a penumbral image but to absorption in the frame which supports the end of the cone. When this frame is removed, a central well defined field, with a penumbra of the size to be expected from Figure 3, is obtained.

PHOTOGRAPHIC EXAMINATION OF FIELDS PRODUCED BY CONES

Whichever type of cone is used, the photographic examination is of considerable value in detecting irregular irradiation fields. When radiographic tubes are used for superficial therapy, it is frequently found that the aperture in the tube wall is sufficiently large that the target face casts an unexpected shadow and so limits the area of the field. In these cases a permanently mounted circular diaphragm

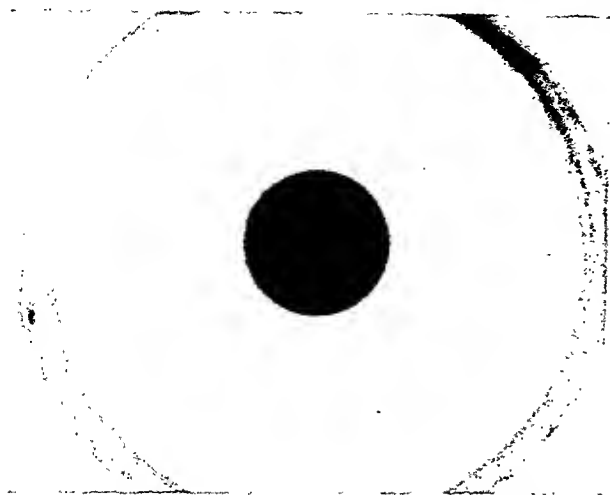


Fig. 6. Leakage of radiation through a badly designed commercial cone.

to define the field of maximum diameter is an advantage. In some deep therapy equipment portions of the filter holder or master cone have been found to cast shadows in the field. Figure 5 shows an example in which the metal fittings of an ionization chamber placed in the master cone have projected within the beam and appreciably reduced the area of field.

In agreement with the experience of Jacobson and of Silverstone and Wolf, a surprisingly large number of diaphragmed cones have shown on photographic examination that the beam does not coincide with the area defined by the face of the cone. In general, this has been due to faulty construction or assembly of the components of the cone, and it appears that a thorough testing of all cones is not carried out before delivery. Fortunately, these errors are usually easy to correct. The most frequent causes of lack of coincidence of the beam with the area of the cone face are lack of parallelism of the side of the diaphragm (for a rectangular port) with the side of the face of the cone, and the lateral translation of the central point of the cone face relative to the central point of the diaphragm aperture.

Photographic examination of the fields produced by cones is actually justified by the number of times in which unsuspected leakage of radiation through badly designed cones is detected. Figure 6 shows

an example of such leakage, which has been found in all cones of the one type tested. This cone was intended to give a small circular field. The intensity of the radiation leakage was sufficient to cause definite skin damage in a prolonged treatment. It will be noticed that the 7 X 17 inch film used in the photograph of Figure 6 was not large enough to show the complete ring of leakage radiation. In the case of the first cone of this type examined the initial examination of the field was carried out with a film just large enough to record the main beam, and the leakage radiation was not detected until later when the reason for the epilation of a patient in an area some distance from the lesion treated was being investigated.

VARIATION OF FREE AIR OUTPUT WITH AREA OF CONE

Although with cones of the side-diaphragm type some variation of x-ray output can be obtained with area of field, in general this does not occur with cones of the tri-diaphragm type. A recently installed therapy equipment was fitted with a type of master cone containing two sets of adjustable lead diaphragms at right angles to each other, so that an infinite number of rectangular treatment ports could be obtained. Measurements of the x-ray output showed no variation greater than the experimental error for fields with areas ranging from 18 to 625 sq. cm. Table I sets out a number of these free air outputs for various areas of field. The individual values were derived from one measurement of the time required to deliver 20 r using a calibrated Hammer dosimeter. Where a slightly discrepant value was obtained, it was recorded, and thus possible errors in individual readings due to variation in supply voltage, tube current, etc., are shown in the values shown. The readings for the circular fields were made by inserting a number of circular apertures below the master cone when the adjustable diaphragms were wide open. With areas smaller than 18 sq. cm., some decrease in the free air dose was found. This result is

TABLE II: UNIFORMITY OF FREE AIR OUTPUT WITH AREA OF FIELD

Field in cm.	Free Air Output r/min.
1.8 circle.....	22.8
3.0 circle.....	23.2
7.5 × 7.5.....	22.7
5 × 12.5.....	22.7
3.0 circle.....	23.2
5 × 15.....	22.8
3 × 5.....	22.7
1.0 circle.....	23.4
0 × 10.....	23.4
5 × 15.....	23.4
0 × 20.....	23.2
5 × 25.....	22.8
Mean 23.0 ± 1.2 per cent	

in agreement with those obtained with cones of fixed area.

The decrease in output with cones of small area may be due to two causes: (1) The focal spot may not be situated centrally with respect to the aperture in the tube wall. (2) The cone diaphragm may not be situated centrally with respect to this aperture. In either case, the decrease becomes greater the smaller the area of the cone, or the larger the focal spot of the tube. For this reason, the use of very small cones (with a field of diameter 1 cm.) with tubes with a focal spot of approximately the same diameter invariably leads to a greatly decreased output and non-uniform irradiation over the field. Even with cones of larger area, errors due to either of the above causes will introduce an appreciable variation of intensity over the area of the field.

It is now a routine procedure during the initial calibration of any tube by this laboratory to check the centering of the focal spot, and of the cone mounting, with a pin-hole camera. The camera consists of a rigid steel framework, carrying on a platform at the lower end a film holder in contact with which fine wires are stretched to produce fiducial lines on the film. The pin hole is carried on an intermediate platform, while to the upper platform can be attached the appropriate adaptors so that the camera can be mounted on any type of tube housing in place of the treatment cone. During the exposure, there is sufficient off-focus radiation to register the cross wires clearly on the film. Two



Fig. 7. Pin-hole camera photographs showing displacement of the focal spot from the geometrical center of the x-ray tube. A truly centered focal spot would lie on the single reference line equidistant from the double reference lines. A. Focal spot displaced along tube axis. B. Focal spot displaced at right angles to tube axis.

separate pin-hole photographs are taken, the cone adaptor being reversed on the tube mounting for the second exposure. If the image of the focal spot occupies an identical position on each film, then the cone mounting is correctly centered and aligned, while lack of centering of the focal spot is determined by the image falling away from the center of the cross wires. Two typical pin-hole photographs are shown in Figure 7. It is our experience that the focal spot is usually correctly centered in the tube axis, but may be displaced along the axis. In some cases this displacement has been due to the position in which the tube is located in the tube housing. We have not found any tube to show such large departures from centering as were found by Jacobson. Even small displacements can, however, seriously affect the distribution through cones of small area; for example, with one equipment having a tube with focal spot 10 mm.

TABLE III: VARIATION OF FREE AIR OUTPUT WITH CONES OF SMALL AREA

Treatment Cone Diameter in cm.	Free Air Output r/min.
2.0.....	18.0
2.5.....	21.1
3.0.....	22.5
Open port.....	22.5

in diameter displaced 7 mm. from the axis of the cone, the free air outputs shown in Table III were obtained with different cones.

Photographic examination of the field given by the 2-cm. cone showed a wide variation in intensity over the area, as would be expected when a portion of the focal spot lay outside the cone of radiation selected by the diaphragm. To avoid this difficulty, we do not recommend the use of small diameter cones, but prefer to use a larger diameter cone (from 3 to 5 cm. depending upon the size of the focal spot) and to limit the beam to the desired area by a lead screen with a suitable aperture attached to the skin with adhesive tape. It should be emphasized that the use of small cones has another disadvantage in that it is more difficult to ensure that the beam covers the desired area, both at the commencement of treatment and during the exposure, when slight involuntary movement of the patient may seriously disturb the alignment.

GENERAL SHAPE OF COMPRESSION CONES

In many cases, the shape of compression cones is not satisfactory. Treatment cones with parallel sides are more readily introduced into body angles (such as the neck) than those which converge from the maximum area of the master cone. The painting of lines on the walls of treatment cones to mark the direction of the central and extreme rays is an advantage in assisting in correct alignment. The exit surface of many cones is a plane at right angles to the central ray and forms sharp edges at the intersections with the walls. These edges cause discomfort and seriously limit the degree of compression which can be applied, particularly in anatomical sites adjacent to bony points. All cone faces

should be gently rounded, and the edge finished in a smooth curve. A compression cone molded from a transparent plastic would have many advantages.

INTRACAVITY TYPE CONES

In some cases intracavity type cones are supplied with high-voltage equipment in an attempt to provide technics similar to those of Chaoul and of Schaeffer-Witte. In general, these cones are not particularly satisfactory from the physical point of view. In one example, a lead-lined converging cone rigidly attached to the tube housing is used with a variety of metal intra-oral specula and hard rubber intravaginal specula. In practice, the converging cone simply bears against the end of the speculum, free relative movement being possible. The fields of these applicators have been examined photographically and it was shown that a lack of alignment of less than 5 degrees (an inclination which is often undetected by untrained personnel between the axes of the cone and the speculum results in an appreciable portion of the exit area of the speculum being completely shielded from radiation (see Figure 8). Even if the cone were correctly set up initially, a movement of this amount could easily be undetected during a treatment. In any case, the converging nature of both the cone and the speculum results in a shielded cone with a considerable proportion of scattered radiation which makes any accurate determination of skin and depth dose extremely difficult.

With the hard rubber intravaginal specula, a further difficulty is introduced due to the leakage of radiation. Although each speculum is provided with a detachable "x-ray protective ring," it is evident from Figure 9 that a very appreciable quantity of radiation is delivered outside the exit area of the speculum. The fact that this leakage traverses the surface of the vagina is an additional disadvantage.

Our experience with cones of these types leads to the conviction that they should be carefully examined from the physical point of view before use is made of them.

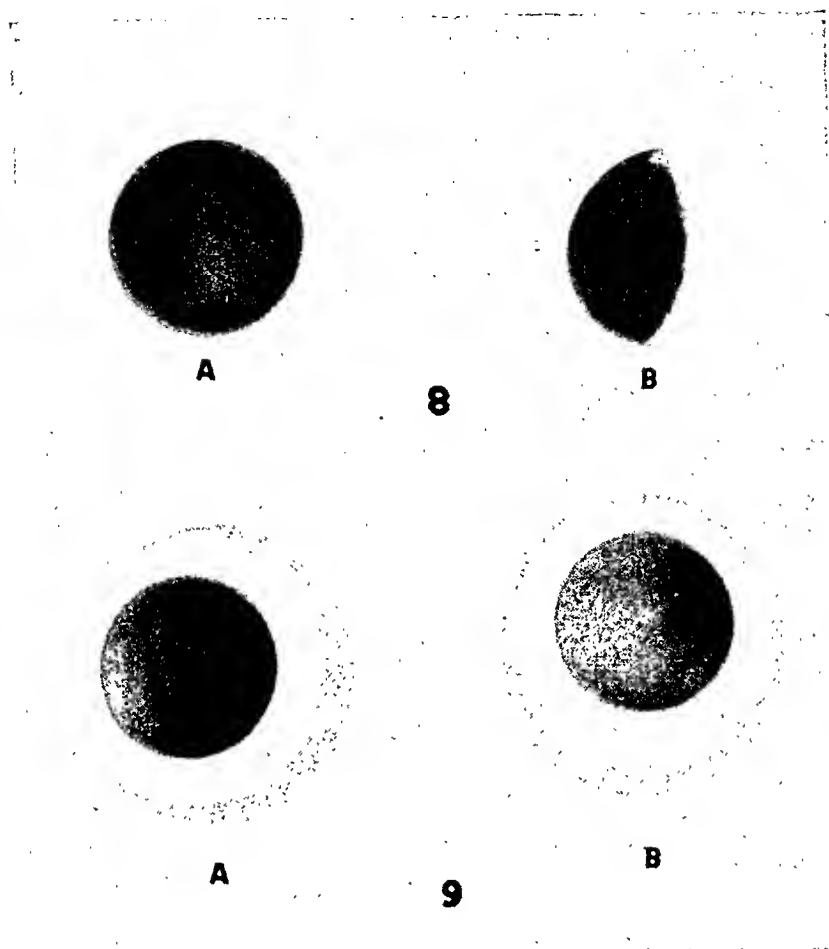


Fig. 8. Fields produced with intra-oral specula (A) correctly aligned, and (B) out of alignment by 5 degrees.

Fig. 9. Fields produced with hard rubber intravaginal specula (A) without and (B) with "x-ray protective ring."

SUMMARY

As a result of experience with different types of treatment cones, it is believed that many of them suffer from serious disadvantages from a physical point of view. It is suggested that careful attention to physical requirements would lead to the introduction of cones which would be more satisfactory in practical application. It is claimed that treatment cones in which the field is defined by an aperture at the top of the cone are more satisfactory than those which define the field by means of radiopaque walls.

The desirability of photographically examining the field produced by each cone is emphasized, and examples are given of typical defects which have been detected.

It is shown that the field produced by extremely small cones is often non-uniform and has a lower dosage than would be expected and that the extent of this depends upon the dimensions of the focal spot and upon the lack of accurate centering of the focal spot with respect to the cone axis.

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EDITORIAL

The Latent Period Which Elapses Between the Onset of a Lesion and the Appearance of Radiographic Signs

A comparative macroscopic and radiographic study of such structures as the lungs or bones, the details of which appear to be so entire in the radiograph, readily reveals to the competent observer the fact that lesions need to have attained a sufficient size or have led to sufficient change before they will produce a contrast density which permits of their detection on the radiograph. Large lesions may be present, yet the radiograph will not reveal them. Obviously, considerable histologic change may occur before any macroscopic alteration is detected. In tissues other than bones and lungs, where the pathological changes produce no material increase in density, we are entirely dependent upon evidence of deformity of such contours of the affected or adjacent tissues as can be demonstrated by radiology. It should not be astonishing, therefore, to realise that it takes time for radiographic signs to become recognisable after the onset of any assault, whether it be on the patient or on the pathologic process by medicaments, etc.

The latent period in association with infectious diseases, *i.e.*, that period which elapses between infection and the appearance of clinical signs, is well recognised, but it is not appreciated as much as it should be that, while the clinical signs in the early stages of disease or following an injury may be very prominent, the radiograph may still fail to reveal any abnormality at the site. Perhaps even less is it recognised that, after the initial clinical signs have faded, radiographic evidence may still be absent or so insignificant that it may be missed by any but the experi-

enced observer, and that, when radiographic signs are well marked, the clinical signs may be insignificant. In other words, the radiographic signs lag behind the clinical at the onset, throughout the duration, and during resolution.

The duration of this lag shows considerable variation in different conditions. In some, as pneumonia, it is short; in others, as cysticercosis, it may be five or ten years. While we must, therefore, think of a negative latent radiographic period following onset, we must think also of the positive radiographic period which exists after the disappearance of clinical signs. In some conditions positive radiographic evidence persists throughout the remainder of an apparently healthy life.

Obviously, radiographs during the latent radiographic period will reveal no evidence of the disease, though it may be present. Further radiographs must be taken after an interval depending on the condition, if we wish to obtain confirmatory evidence. The interval between the first negative radiograph and the request for the second, which shows positive signs, is usually much longer than the latent radiographic period—probably because the first radiograph was of a patient with prominent symptoms which have shown some abatement in the interval, a second being called for only because of a recrudescence of symptoms or their failure to clear within a reasonable time. In the case of the latent period at the onset of a recurrence, we may have an additional difficulty, *i.e.*, residual radiographic evidence of healed disease but no indication of reactivity.

Failure to appreciate the discrepancy be-

seen clinical and radiographic signs has often had an unfortunate bearing on the treatment of the patient. A few instances may be given from the many which occur. Following trauma to a bone or dislocation of a joint, the radiographic signs of damage may not be detected for weeks, months, or even a year or so, during which time the clinical signs and symptoms may have gone and the unfortunate patient may be enraged or even compelled to use—and destroy—the limb or joint. In such cases the surgeons are liable to blame for these mistakes in so far as they deliberately failed to seek the co-operation of their radiological colleagues. Radiographic evidence of osteomyelitis does not appear for a few days or more after the onset of prominent clinical signs. To wait for it would be disastrous. In malignant disease of a deep organ and in malignant metastases in bone, clinical signs or symptoms may be present for months or a year or more before there is radiographic evidence. Carcinoma of the rectum may not only produce prominent clinical signs and symptoms but may even be detected by digital examination at a time when a thorough radiographic examination is negative. One is to think merely of the lack of radiographic evidence in the first two months of normal pregnancy to realise how large a omission and how prominent the physical signs can be without any radiological evidence. It has been shown that in the case of pregnancy with foetal osteogenesis imperfecta the foetal skeleton may not be cognisable even at full term. Until recently, cerebral tumours could grow to great size without producing any radiographic evidence and, even with the aid of contrast media, the negative latent radiographic period may be long.

In the case of such a condition as tuberculosis, where there is a tendency to assign prime importance to radiographic evidence for detection of the lesions and isolation of the patient, the negative latent radiographic period at the onset of the disease in the bones and the lungs, the

persistence of the radiographic evidence when all the clinical signs have gone, and the delay between the recurrence of symptoms and the appearance of new radiographic evidence in addition to that which indicates healed disease, all call for very serious consideration. The clinical signs of tuberculosis of the bones and joints may be prominent for months or even a year or more before any confirmatory evidence can be obtained radiographically. Unfortunately, the negative radiographic evidence at onset of the primary lesion or the reactivation is apt to be relied upon as conclusive evidence of freedom from the disease, and no further request is made until months later, when the worsening of the patient's condition demands it, and then frequently the evidence of extensive disease is only too apparent. From the point of view of preventive medicine, this is particularly unfortunate, for such a patient can unknowingly infect others.

There is an exception which proves the rule that radiographic signs lag behind the clinical, *i.e.*, tumour metastases, hydatid cysts, and certain other conditions of the lungs may produce no local or systemic signs until they have reached a very considerable size, while their detection by radiography is possible long before clinical evidence appears. We radiologists have in the past emphasised and demonstrated what the radiograph will show and we have taught the clinician to expect confirmatory radiographic evidence particularly in cases with prominent clinical signs. We and our colleagues have illustrated our articles and lectures to students with radiographs having characteristic spectacular appearances, but we have said far too little about the many conditions which the radiograph will not show. Consequently, there is a tendency for our colleagues to regard the radiologist as incompetent and the radiograph as poor if it fails to furnish confirmatory evidence when clinical evidence is prominent.

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Birmingham, England

ANNOUNCEMENTS AND BOOK REVIEWS

AMERICAN COLLEGE OF PHYSICIANS

The American College of Physicians will resume its Annual Meetings in 1946 and has now definitely chosen Philadelphia as the place and May 13-17 as the time. Headquarters will be at the Philadelphia Municipal Auditorium, 34th Street below Spruce.

The Meeting will be conducted under the Presidency of Dr. Ernest E. Irons of Chicago and the General Chairmanship of Dr. George Morris Piersol of Philadelphia.

JUBILEE ASSEMBLY

Under the above title, the Radiological Section of the Palestine Jewish Medical Association has published a collection of papers presented in observation of the tenth anniversary of its founding and the fiftieth of Roentgen's discovery of the x-ray.

The papers, which are printed in both Hebrew and English, include: Fifty Years of Roentgenology, by R. Link; Radiology and the American Jew, by I. Kaplan; The Development of Physics Since the Discovery of the X-Rays, by E. Alexander; The Significance of the Menopause for Mammary Carcinoma, by L. Halberstaedter and A. Hochman; The Roentgenological Pathology of Fractures, by L. Drey; The Tactics of Roentgen Examination of the Urinary Tract in Connection with Pyeloscopy, by H. Salinger and F. Saalberg; Fifty Years' Progress in X-Ray Photographic Materials, by H. S. Tasker. Appended is a glossary of Hebrew roentgenologic terms with their English equivalents.

The volume carries the dedication "To the scientists of all nations who sacrificed their lives for the advancement of roentgenological science and to the physicians and scientists of Israel and of the nations of the world who fell in their fight against the dread of Nazism."

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

CLINICAL ROENTGENOLOGY OF THE HEART. ANNALS OF ROENTGENOLOGY, VOL. XVIII. By JOHN B. SCHWEDEL, M.D., Associate Attending Physician, Medical Division, Adjunct Attending Physician, Department of Roentgenology, Montefiore Hospital, New York; Attending Electrocardiographer and Associate Visiting Physician in Medicine, Gouverneur Hospital, New York; Lieutenant Commander, M.C. (V)S., U.S.N.R.

A volume of 380 pages, with 749 illustrations, 232 figures. Published by Paul B. Hoeber, Medical Book Department of Harper & Brothers, New York, 1946. Price \$12.00.

Book Reviews

DR. W. C. RÖNTGEN. By OTTO GLASSER, Cleveland Clinic Foundation. A volume of 169 pages, numerous illustrations. Published by C. C. Thomas, Springfield, Ill., 1945. Price \$15.

Otto Glasser, who has established his reputation as Röntgen's biographer by his earlier account of the life of the great physicist in both German and English, has prepared a new volume in honor of the one-hundredth anniversary of Röntgen's birth and the fiftieth anniversary of his discovery of "a new kind of rays." The book is sponsored jointly by the American Roentgen Ray Society, the Radiological Society of North America, and the American College of Radiology.

It is a small volume of 169 pages, printed on paper and in an attractive format, though one might wish that a somewhat better binding had been used. Much of the material was included in the author's previous life of Röntgen but enough that is new has been added to furnish an interesting supplement to the earlier work.

The material covers the main events of Röntgen's life, with special emphasis on the period of his accidental discovery and the ensuing years. The style is simple and graceful and Röntgen's home life and scientific pursuits are presented with unusual vividness. One almost shares his surprise as on that memorable Nov. 8 he lighted a match and "discovered" that the source of the mysterious light was the barium platinocyanide screen lying on the bench. New translations of the three communications in which the discoverer accurately describes the rays and their physical characteristics are included and a bibliography of all Röntgen's scientific papers as well as a chronology of his life are appended.

THE 1945 YEAR BOOK OF RADIOLOGY. Edited by CHARLES A. WATERS, M.D., Associate in Roentgenology, Johns Hopkins University; Assistant Visiting Roentgenologist, Johns Hopkins Hospital; Associate Editor, WALTER H. FIROR, M.D., Assistant in Roentgenology, Johns Hopkins University; Assistant in Roentgenology, Johns Hopkins Hospital (on leave with the Armed Forces). Therapeutics, edited by IRA L. KAPLAN, B.Sc., M.D., Director, Radiation Therapy Department, Bellevue Hospital, New York City; Clinical Professor of Surgery, New York University Medical College. A volume of 464 pages.

with 342 illustrations. Published by The Year Book Publishers, Inc., Chicago, Ill. Price \$5.00.

The 1945 "Year Book of Radiology" is the fourth of this series of volumes, bringing together in its form not only the significant contributions to radiological literature for the past year but including, also, scattered articles of radiologic interest from a large number of clinical journals. The abstracts are carefully prepared and many illustrations from the original papers are reproduced. It is gratifying to find *Acta Radiologica* once again represented.

In making up the volume, the illustrations have been placed in closer juxtaposition to the text with which they belong than in some of the earlier Year Books. This is of distinct advantage, but still further improvement could be made by printing beneath each cut the original reference with the name of the author and the journal from which the abstract was prepared. Not only would this be of benefit to the reader but it would give well deserved credit to the many journals from which the material is drawn.

Like its predecessors, the book is divided into two sections—on diagnosis and therapy. Both are arranged in general on an anatomical basis. The therapy section is prefaced by a useful introduction furnishing a general survey of the field and includes two sections on Radiation Biology and Radiation Physics.

The book is well printed and attractively bound in the general style of the earlier volumes. A useful index is included. This series of books is of increasing value for quick reference to individual subjects and for its comprehensive summary of the current literature.

KETTLE'S PATHOLOGY OF TUMORS. Edited by W. G. BARNARD AND A. H. T. ROBB-SMITH. A volume of 318 pages. Third Edition. H. K. Lewis and Co., Ltd., London, 1945. Price 21 shillings.

There are few medium-sized books in English which are devoted solely to the discussion of the gross and microscopic essentials of the morphology of tumors, while the few good French and German texts are inaccessible to most students, owing to the barrier of language. Kettle's small volume, originally appearing in 1916, was the first compact treatise in English to contain sufficient information for the interne or hospital resident. The author had considerable skill in drawing and prepared many of the excellent illustrations in the first edition, which numbered 224 pages. This third edition contains 18 pages and 65 additional cuts, most of which are photomicrographs.

The new editors are amply equipped for their task, as a cursory survey of the text will show. The most

important expansion has taken place in the consideration of tumors of the nervous system. No valuable space has been wasted in useless theoretic discussions or in descriptions of those extremely rare tumors which are met with only a few times in the ordinary physician's professional life. These are dismissed, as a rule, with a short note and references to sources where fuller details can be obtained. A short but sufficiently complete section is devoted to a survey of the experimental study of cancer, and the essential facts as regards the etiology of the disease are covered in twelve pages.

The reproduction of Kettle's drawings and of the new photographic cuts is excellent. The reviewer's only criticism is that the magnification of the drawings is expressed in the Teutonic style, by giving the focal length of the objective and the number of the ocular. As the focal length of the objective is not always as stated by the manufacturer, and eye-pieces of the same number vary considerably, it would be better if the magnifications were expressed in the proper fashion, that is, in actual diameters. In comparing pictures with a section for diagnosis, it is sometimes helpful to know the magnification. Also, a certain number of the otherwise excellent composite cuts have been reversed, presumably by the printer, so that the legends do not correctly indicate the areas described.

The writer knows of no more convenient and competent short treatise on tumors than this revision of Kettle by Barnard and Robb-Smith. It should be widely used. The price in England is \$4.25, but this country, while talking loudly on the advantages of research, proceeds to tax it by still retaining the astounding practice of imposing an import duty on books printed in English.

PHYSICAL CHEMISTRY OF CELLS AND TISSUES. By RUDOLF HÖBER, University of Pennsylvania School of Medicine, Philadelphia. With the collaboration of DAVID I. HITCHCOCK, Yale University School of Medicine, Laboratory of Physiology, New Haven, Conn., J. B. BATEMAN, Mayo Clinic, Rochester, Minn., DAVID R. GODDARD, University of Rochester, Biological Laboratories, Rochester, N. Y., and WALLACE O. FENN, University of Rochester, School of Medicine and Dentistry, Rochester, N. Y. A volume of 676 pages, with 70 illustrations. Published by The Blakiston Company, Philadelphia. Price \$9.00.

"Physical Chemistry of Cells and Tissues" by Rudolf Höber will, as the title indicates, be of greatest interest to those engaged in research in biophysics, physiology, and biochemistry, the more so as the writers have assumed a considerable knowledge of mathematics and physical chemistry on the part of their readers.

The first section of the book, by David I. Hitchcock of Yale, deals in a systematic manner with laws and principles of physical chemistry and their appli-

pitals, Boston, Mass. Meets monthly on third Friday at Boston Medical Library.

NEW HAMPSHIRE

New Hampshire Roentgen Society.—Secretary-Treasurer, Richard C. Batt, M.D., St. Louis Hospital, Berlin.

NEW JERSEY

Radiological Society of New Jersey.—Secretary, H. R. Brindle, M.D., 591 Grand Ave., Asbury Park. Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called.

NEW YORK

Associated Radiologists of New York, Inc.—Secretary, William J. Francis, M.D., East Rockaway, L. I.

Brooklyn Roentgen Ray Society.—Secretary-Treasurer, Leo A. Harrington, M.D., 880 Ocean Ave., Brooklyn 26. Meets fourth Tuesday of every month, October to April.

Buffalo Radiological Society.—Secretary-Treasurer, Joseph S. Gian Franceschi, M.D., 610 Niagara St., Buffalo 1. Meetings second Monday evening each month, October to May, inclusive.

Central New York Roentgen Society.—Secretary-Treasurer, Carlton F. Potter, M.D., 425 Waverly Ave., Syracuse 10. Meetings in January, May, and October.

Long Island Radiological Society.—Secretary, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meetings fourth Thursday evening each month at Kings County Medical Bldg.

New York Roentgen Society.—Secretary, Wm. Snow, M.D., 941 Park Ave., New York 28.

Rochester Roentgen-Ray Society.—Secretary, Murray P. George, M.D., 250 Crittenden Blvd., Rochester 7. Meets at Strong Memorial Hospital, third Monday, September through May.

NORTH CAROLINA

Radiological Society of North Carolina.—Secretary-Treasurer, Major I. Fleming, M.D., 404 Falls Road, Rocky Mount. Meets in May, and October.

NORTH DAKOTA

North Dakota Radiological Society.—Secretary, Charles Heilman, M.D., 1338 Second St., N., Fargo.

OHIO

Ohio Radiological Society.—Secretary, Henry Snow, M.D., 1031 Reibold Bldg., Dayton 2. Next meeting at annual meeting of the Ohio State Medical Association.

Cleveland Radiological Society.—Secretary-Treasurer, Carroll C. Dundon, M.D., 2055 Adelbert Road, Cleveland 6. Meetings at 6:30 P.M. on fourth Monday of each month from October to April, inclusive.

Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists).—Secretary-Treasurer, Samuel Brown, M.D., 707 Race St., Cincinnati 2. Meetings held third Tuesday of each month.

PENNSYLVANIA

Pennsylvanian Radiological Society.—Secretary-Treasurer, L. E. Wurster, M.D., 416 Pine St., Williamsport 8. The Society meets annually.

Philadelphia Roentgen Ray Society.—Secretary, Calvin L. Stewart, M.D., Jefferson Hospital, Philadelphia 7. Meets first Thursday of each month at 8:00 P.M., from October to May, in Thomson Hall, College of Physicians, 21 S. 22d St.

Pittsburgh Roentgen Society.—Secretary-Treasurer, M. J. Freedman, M.D., 4800 Friendship, Pittsburgh 24. Meets second Wednesday of each month at 6:30 P.M., October to May, in The Ruskin, 120 Ruskin Ave.

ROCKY MOUNTAIN STATES

Rocky Mountain Radiological Society (North Dakota, Nebraska, Kansas, Texas, Montana, Colorado, Idaho, Utah, New Mexico).—Secretary, A. M. Popma, M.D., 229 North 10th, Boise, Idaho.

SOUTH CAROLINA

South Carolina X-ray Society.—Secretary, Robert B. Taft, M.D., 103 Rutledge Ave., Charleston.

TENNESSEE

Memphis Roentgen Club.—Chairman, meetings monthly in alphabetical order. Meetings second day of each month at University Center.

Tennessee Radiological Society.—Secretary, J. Marsh Frère, M.D., 707 Walnut St., Chattanooga. Meeting annually with State Medical Society.

TEXAS

Dallas-Fort Worth Roentgen Study Club.—Secretary, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth. Meetings on third Monday of each month in Dallas the odd months and in Fort Worth in the even months.

Texas Radiological Society.—Secretary-Treasurer, E. Seeds, M.D., Baylor Hospital, Dallas.

VIRGINIA

Virginia Radiological Society.—Secretary, E. J. Flanagan, M.D., 215 Medical Arts Bldg., Richmond.

WASHINGTON

Washington State Radiological Society.—Secretary-Treasurer, Thomas Carlile, M.D., 1115 Terry Ave., Seattle. Meetings fourth Monday of each month from September through May, at College Club, Seattle.

WISCONSIN

Milwaukee Roentgen Ray Society.—Secretary-Treasurer, C. A. H. Fortier, M.D., 231 W. Wisconsin Ave., Milwaukee 3. Meets monthly on second Monday at University Club.

Radiological Section of the Wisconsin State Medical Society.—Secretary, S. R. Beatty, M.D., 185 E. Oshkosh. Two-day annual meeting in May and one day in connection with annual meeting of State Medical Society in September.

University of Wisconsin Radiological Club.—Secretary, Meets first and third Thursdays, 4 to 5 P.M., September to May, inclusive, Room 301, Service Building, 426 N. Charter St., Madison 6.

CANADA

Canadian Association of Radiologists.—Honorary Secretary-Treasurer, J. W. McKay, M.D., 1620 Cedar St., Montreal.

La Société Canadienne-Française d'Electro-Radiologie Médicales.—General Secretary, Dr. J. J. Fresne, M.D., Institut du Radium, Montreal. Meets third Saturday of each month.

CUBA

Sociedad de Radiología y Fisioterapia de Cuba.—Secretary, in Hospital Mercedes, Havana. Meets monthly.

ABSTRACTS OF CURRENT LITERATURE

ROENTGEN DIAGNOSIS

Head and Neck

- FLY, GILBERT N. Value of Routine Roentgenographic Studies of War Injuries of the Head and Neck..... 193
- DUNE, WM. S., AND WOODHALL, BARNES. Skull Defect and Herniation of Cerebrum with Absence of Dura Following Head Injury in Adolescence..... 193
- ONICK, M. J., AND OLJENICK, IGNAZ W. Displacement of Pincal Gland with Extradural Hemorrhage..... 193
- GHT, R. WESLEY, AND BOYD, HAROLD M. E. Acrosinusitis..... 193

Chest

- HOF, HAROLD. Acute Putrid Abscess of the Lung..... 193
- WARDS, PETER W., AND PENMAN, A. CLARK, WITH BLAIR, L. G. Primary Tuberculous Infection in a Sanatorium Staff. Investigation and Supervision..... 194
- NSILVER, OSCAR. Mechanical Paralysis of the Left Hemidiaphragm Complicating Collapse Therapy in Pulmonary Tuberculosis..... 194
- ER, HOWARD, HAWN, CLINTON VAN ZANDT, AND THORN, GEORGE. Report of a Case of Acute Interstitial Fibrosis of the Lungs..... 194
- LS, WALTER L. Pitfalls in the Diagnosis of Atypical Pneumonia..... 195
- CKER, E., ROSE, S. P., AND TUMEN, A. O. Pneumococcic Pneumonia Resembling Primary Atypical Pneumonia..... 195
- IMITZ, ROBERT C. Primary Atypical Pneumonia of Unknown Cause..... 195
- VENSTEIN, ARNOLD F. Ingestion of Kerosene Complicated by Pneumonia, Pneumothorax, Pneumopercardium, and Subcutaneous Emphysema..... 195
- NDERGRASS, EUGENE P., AND LEOPOLD, SIMON S. Benign Pneumoconiosis..... 195
- LAUGHLIN, A. I. G., GROUT, J. L. A., BARRIE, H. J., AND HARDING, H. E. Iron Oxide Dust and the Lungs of Silver Finishers..... 196
- JINNER, LASAR. Observations on Pulmonary Disease in Graphite Workers..... 196
- KELES, A., AND GLYNN, L. E. Serial Roentgenograms of the Chest in Periarthritis Nodosa as an Aid to Diagnosis. With Notes on the Pathology of the Pulmonary Lesions.... 196
- ANBERG, TORE. Roentgenographical Pulmonary Changes in Periarthritis Nodosa... 196
- HERLIS, SIDNEY. Locflier's Syndrome—Eosinophilic Pneumonia. Case Report..... 197
- BARNLEY, G. R. Blast Injury to the Lungs: Clinical and Radiological Findings and Their Relation to Certain Symptoms..... 197

- SAVAGE, OSWALD. Pulmonary Concussion ("Blast") in Non-Thoracic Battle Wounds.. 197
- OCHSNER, ALTON, DIXON, J. LEONARD, AND DEBAKEY, MICHAEL. Primary Bronchiogenic Carcinoma..... 197
- BLOCH, ROBERT G., ADAMS, WILLIAM E., THORNTON, THOMAS F., AND BRYANT, J. EDMOND. Difficulties in the Differential Diagnosis of Bronchogenic Carcinoma 198
- MCDONALD, JOHN R., HARRINGTON, STUART W., AND CLAGETT, O. THERON. Hamartoma (Often Called Chondroma) of the Lung.... 198
- ISBISTER, JAMES. Case of Besnier-Bocock-Schaumann Syndrome, or Benign Lymphogranulomatosis, with Pneumothoraces..... 198
- FARBER, JASON E., AND MILLER, D. K. "Beriberi Heart" in a Tuberculous Patient..... 199
- MILLER, HERBERT C. Cardiac Hypertrophy and Extramedullary Erythropoiesis in Newborn Infants of Prediabetic Mothers..... 199
- RENANDER, AXEL. Radiographic Examination of a Case of Cancer of the Thymus..... 199

The Digestive System

- GRUBER, WALTER F. A New X-Ray Method of Studying the Anatomy and Motility of the Stomach and Duodenum: Its Diagnostic Value..... 199
- ST. JOHN, FORDYCE B., SWENSON, PAUL C., AND HARVEY, HAROLD D. An Experiment in the Early Diagnosis of Gastric Carcinoma..... 200
- LEE, MAURICE. Intestinal Obstruction by Gall-Stones..... 200
- SCHEPERS, G. W. H. Pathology of Regional Ileitis..... 200
- DAHL-IVERSEN, E., AND FOGH, BØRGE. On the Reduction of Ileal-Ileocolic Intussusception by Means of Contrast Enema..... 200

Abdominal Injuries

- MCGRIGOR, D. B., AND SAMUEL, ERIC. Radiology of War Injuries. Part 1. War Wounds of the Abdomen..... 201

The Musculoskeletal System

- BRAILS福德, JAMES F. Sclerosing Sarcoma of Bone. (Dangers of Biopsy)..... 201
- CASTRONUOVO, JOHN J. Renal Osteodystrophy. Report of a Case of Unusual Pathogenesis... 201
- OFFENHEIMER, ALBERT. Diseases of the Vertebral Column: A Roentgenologic Analysis..... 202
- LYON, ERNST. Uncovertebral Osteophytes and Osteochondrosis of the Cervical Spine..... 202
- SOULE, ARTHUR B., JR., GROSS, SIDNEY W., AND IRVING, JAMES G. Myelography by the Use of Pantopaque in the Diagnosis of Herniations of the Intervertebral Discs..... 202

- EAGLESHAM, D. C. Observations on Opaque Myelography of Lumbar Disc Herniations... 202
- DAVIES, HUGH. Lateral Prolapse of the Cervical Intervertebral Disc..... 203
- SAMUEL, ERIC. Congenital Absence of the Pectoralis Major..... 203
- GRAY, H. Arachnodactyly (Spider Fingers).... 203
- HOWORTH, M. BECKETT. Calcification of the Tendon Cuff of the Shoulder..... 203
- SCHMIER, ADOLF A. The Internal Epicondylar Epiphysis and Elbow Injuries..... 203

Gynecology and Obstetrics

- MAGNUSSON, WOLFGANG. Radiographic Manifestation of Tuberculous Salpingitis..... 204

The Genito-Urinary Tract

- DRAPER, JOHN W., AND SICELUFF, JOSEPH G. Excretory Cysto-Urethrograms..... 204

The Blood Vessels

- NORGORE, MARTIN. Clinical Anatomy of the Vertebral Veins..... 204
- LOWMAN, ROBERT M., AND DOFF, SIMON D. Arteriography for the Demonstration of Intracranial Aneurysms..... 204
- CLAUSEN, ARNE. Peripheral Aneurysm of the Pulmonary Artery..... 205
- WESTERMARK, NILS. A Method for Determining the Blood Pressure in the Pulmonary Artery. 205
- NELSON, O. A. Arteriography in Renal and Abdominal Conditions..... 205

Gas Gangrene

- KEMP, F. H. X-Rays in Diagnosis and Localisation of Gas-Gangrene..... 205

Technic

- MORGAN, RUSSELL H. Automatic Exposure Control in Photofluorography..... 206
- MCDUGALL, J. B. Tomography..... 207
- ROBIN, PERCIVAL A. A Simple Apparatus for Body Section Radiography..... 207
- SOHRNE, GUNNAR. Diagnostic Use of Radioactive Common Salt..... 207

RADIOTHERAPY

Neoplastic Disease

- LEDERMAN, M., AND CLARKSON, J. Radium Treatment of Cancer of the Oesophagus.... 207

- KERR, H. DABNEY, AND EINSTEIN, ROBERT A. J. Results of Irradiation of Ovarian Tumors... 207
- THORÉN, S. Electroendothermy as an Adjunct to Radiotherapy in Uterine Cancer..... 207
- GILES, ROY G. Wilms' Tumor of the Kidney... 207
- KASABACH, H. H., AND DONLAN, C. P. Roentgenotherapy of Hemangioma of the Leg in Infants..... 207
- POHLE, ERNST A., PAUL, LESTER W., AND CLINE, ELIZABETH A. Roentgen Therapy of Bone Sarcoid..... 207

Non-Neoplastic Disease

- BORAK, J. Tendogenetic Disease and Its Treatment with X-Rays..... 207
- BEHRENS, CHARLES F. Some Roentgenographic Considerations Pertaining to Upper Extremity Pain..... 207
- HARVEY, ROGER A., SPINDLER, HOWARD A., AND DOWDY, ANDREW H. Roentgen Therapy as an Adjunct in the Management of Acute Postpartum Mastitis..... 207
- SCHOURUP, K. Plastic Induration of the Penis..... 207

Technic and Dosage

- UNGAR, EMIL. Standardisation of Techniques in Radiotherapy..... 207
- GRAY, L. H., ELLIS, F., FAIRCHILD, G. C., AND PATERSON, EDITH. Dosage Rate in Radiotherapy. A Symposium..... 207
- SPIEGLER, G. Photographic Methods Applied to Dosimetric Problems..... 207
- MEREDITH, W. J., AND STEPHENSON, S. K. Use of Radiographs for Dosage Control in Interstitial Gamma-Ray Therapy..... 207
- VICTOREEN, J. A., ATLEE, Z. J., AND TROUT, E. D. Behavior of Thimble Chambers When Used for the Measurement of Very Soft Radiation..... 207

Effects of Radiation

- HATCHER, C. HOWARD. Development of Sarcoid in Bone Subjected to Roentgen or Radium Irradiation..... 207
- SHEEHAN, JOHN F., SCHMITZ, HERBERT E., AND TOWNE, JANET. Changes in the Uterus after Eradication of Endometrial Adenocarcinoma by Radiotherapy, with Particular Reference to an Infarct-Like Radionecrotic Plaque in the Lining..... 207
- COOPER, A. G. S., AND ROBERTSON, D. F. Treatment of Post-Irradiational Ulcers by Radium Ointment..... 207



ROENTGEN DIAGNOSIS

THE HEAD AND NECK

ue of Routine Roentgenographic Studies of War
es of the Head and Neck. Gilbert N. Haffly.
Otolaryng. 41: 216-217, March 1945.

ase is presented which dramatically illustrates the
of routine roentgen studies of all war wounds in
a retained radiopaque foreign body might be sus-
d. A soldier in the South Pacific area was wounded
e left orbital region by a fragment of an artillery

The left globe was enucleated, and a large ragged
tion of the lower left eyelid and adjacent region
e cheek was repaired with linen sutures within
hours after injury at a nearby evacuation hospital.
entgenographic studies were considered necessary.
days later, at another hospital, the patient was
of complaints except for tenderness in the region
e left orbital wound, which had become secondarily
ted. Roentgen studies now revealed a large me-
fragment wholly within the cavity of the left
liary sinus. The foreign body was removed, and
wound healed primarily, without evidence of sinus
tion.

ull Defect and Herniation of Cerebrum with Ab-
e of Dura Following Head Injury in Adolescence.
S. McCune and Barnes Woodhall. Arch. Neurol.
ychiat. 53: 307-308, April 1945.

ie authors describe an unusual instance of a defect
e inner table of the skull with absence of the dura
associated herniation of the brain following head
y (operative confirmation). Investigation of re-
ent episodes of loss of consciousness led to discovery
an irregular defect in the calvarium at the site of a
l injury sustained some seventeen years previously.
ificant roentgen findings consisted of an area of
"moth-eaten" destruction involving the inner table of
left parietal bone over which tenderness could be
ted on pressure. Pneumoencephalographic studies
wed slight dilatation and upward displacement of
posterior half of the body of the left lateral ven-
le. Deviation of the ventricle toward the defect
gested cortical atrophy in this region. This is an
mple of a degenerative process in the cranium
owing skull fracture during adolescence, unusual in
destruction of the inner table, herniation of the
in into the defect, and absence of the dura. No at-
pt is made to explain the pathogenesis of the dural
ect. This case is offered as an aid in the differential
gnosis of destructive lesions of the calvarium.

GUERDON GREENWAY, M.D.
(University of Michigan)

Displacement of Pineal Gland with Extradural
hemorrhage. M. J. Madonick and Ignaz W. Oljenick.
ch. Neurol. & Psychiat. 53: 311-312, April 1945.
The authors present a case of shift of a partially cal-
ed pineal gland resulting from extradural hemorrhage
owing traumatic rupture of the middle meningeal
ery. Attention is called to the fact that the avail-
e literature dealing with roentgen findings in the
all in cases of extradural hemorrhage is chiefly con-
ned with the presence or absence of a fracture line
assing the groove of the middle meningeal vessels,

little or no emphasis being placed on the associated
shift of the pineal. The authors feel that a relatively
large effusion of blood must be present to produce such a
shift.

GUERDON GREENWAY, M.D.
(University of Michigan)

Aerosinusitis. R. Wesley Wright and Harold M. E.
Boyd. Arch. Otolaryng. 41: 193-203, March 1945.

Acrosinusitis is an acute or chronic sinus inflamma-
tion caused by trauma to the mucous membrane as a
result of a difference between the air pressure within
the sinus and that of the surrounding atmosphere. This
phenomenon occurs commonly during changes in alti-
tude in airplane flights and is accompanied by pain and
discomfort. The pain is acute, localized to one of the
sinus areas, more commonly in the frontal region. As
the pain subsides after equalization of pressure, it may
be replaced by a sense of stuffiness. The patient may
blow blood from the nasal passages of the affected side,
or blood may appear in the nasopharynx and the sput-
tum. In all cases the aerosinusitis and accompanying
symptoms are directly proportional to the rapidity of
the change in pressure on ascent or, more commonly, on
descent.

Reports of roentgen examinations in cases of aero-
sinusitis frequently direct attention to a haziness of
many sinuses or an opacity of one or both antra with
clouding of other sinuses. At times roentgenography is
the only means of detecting the condition, but inability
to focus roentgenographically on any one sinus as the
site of a pathologic process makes statistical analysis
nearly impossible. Occasionally abnormalities are dis-
covered, such as a septal deviation or a pathologic
change in the antra. Either or both could be the causa-
tive condition.

Immediate treatment consists in an attempt to equal-
ize the differential pressure within and without the
sinus. Leveling off and ascent in the low-pressure
chamber are standard procedures when it is necessary to
secure relief from sinus pains. If, as is usually true, the
condition is due to decreased pressure within the sinus
with an increasing pressure without, as occurs on de-
scent, ascent will bring the affected sinus to a level where
the trapped air will be of the same density as the out-
side air. There will then exist no differential, and the
sinus duct or ostium may open easily, with relief of
symptoms. Nasal shrinkage is then used to assure a
patent opening. The treatment of a well developed
condition varies with the severity of the symptoms.
Usually the pain in the sinus or the headache disappears
in a short time and no treatment is necessary other than
that for a pre-existing sinusitis. Hemorrhages in the
sinus mucosa are usually absorbed unless they are too
extensive.

Roentgenograms are reproduced.

THE CHEST

Acute Putrid Abscess of the Lung. Harold Neuhoof.
Surg., Gynec. & Obst. 80: 351-354, April 1945.

Operation has been done in 172 cases of acute putrid
abscess of the lung in the past sixteen years at the
Mount Sinai Hospital (New York) with 4 deaths.

All putrid pulmonary abscesses may be assumed to

ings, physical examination yielded only minimal evidence of the disease. As in 2 of the 4 cases previously described, only scattered râles were heard on examination. Later a pleural friction rub developed; this sign also appeared in 2 of the previous cases.

Clubbing of the fingers was unique in the present case. The roentgen appearance of the lungs suggested miliary tuberculosis, as in 2 of the previous cases.

The cardiac findings were those of chronic cor pulmonale, the heart was definitely enlarged, and there was a loud gallop rhythm. At no time was there evidence of cardiac decompensation. The total duration of the disease appears to have been about seventeen weeks, which is well within the range of four to twenty weeks of the earlier series.

The autopsy findings in the present case included many of the pathological peculiarities of the 4 cases reported by Hamman and Rich. Most outstanding was the marked diffuse interstitial proliferation of fibrous tissue, of a progressive character, throughout all lobes of the lungs. The formation of a hyaline membrane around the alveoli was not conspicuous in this case, nor were there striking numbers of eosinophils in the interstitial connective tissue. The etiology of the underlying pulmonary disease remains obscure.

Falls in the Diagnosis of Atypical Pneumonia. By L. Nalls. *Dis. of Chest* 11: 130-136, March 1945.

In spite of the low mortality from atypical pneumonia, the disease is not to be taken lightly either from the point of view of the individual patient or that of the population as a whole. Of particular importance is its differentiation from other chest diseases. The author is in agreement with the generally prevailing impression that such diagnosis is altogether a simple matter or that the x-ray picture is distinctive. Not only has he recently found it impossible to make a differentiation between pneumococcus and atypical pneumonia on the basis of the roentgenogram alone, but in some instances has been impossible even with all the other available data at hand. Response to therapy has sometimes made the distinction, but the use of sulfonamides in atypical pneumonia is not to be encouraged.

Confusion with tuberculosis is another pitfall, although usually the onset of symptoms is different, the lesions are predominantly in the lower rather than in the upper lobes. The importance of a brief period of observation before instituting active treatment for tuberculosis is of particular importance. In an occasional case small disseminated shadows may suggest a miliary tuberculosis. As these shadows increase in size, the picture may resemble that of metastatic carcinomatosis or one of the fungus diseases.

Confusion with primary carcinoma of the lung has been observed when the roentgenogram shows a very sharply localized area of atelectasis, and the author has seen one case in which a bronchiogenic carcinoma was diagnosed as atypical pneumonia.

Finally, it may well be impossible to differentiate primary atypical pneumonia from bronchiectasis during the acute stage. In this connection the author mentions the "pseudobronchiectasis" reported by Jones and Dugan (*J. Thoracic Surg.* 13: 40, 1944). *Dis. of Chest* 11: 404, 1944) as following atypical pneumonia and points out that, in a case of suspected bronchiectasis after primary atypical pneumonia, it is well to allow a period of observation and repeat the

bronchogram before deciding upon surgical treatment of the bronchiectasis. HENRY K. TAYLOR, M.D.

Pneumococcic Pneumonia Resembling Primary Atypical Pneumonia. E. Raeker, S. P. Rose, and A. O. Tumen. *Am. J. M. Sci.* 209: 496-502, April 1945.

In a large series of cases of pneumococcic pneumonia there are not infrequently seen features which are considered characteristic of primary atypical pneumonia. These are bilateral patchy infiltrations, failure to respond to chemotherapy within forty-eight hours, presence of cold agglutinins, relative bradycardia, spiking temperature, normal or low leukocyte counts, dry cough and scanty sputum, and frontal headache. The absence of a pathogen in the sputum does not exclude the possibility of a bacterial invader. If one accepts the main criteria of atypical pneumonia as patchy bronchopneumonic infiltration of the lungs and a failure to respond to chemotherapy, the incidence of atypical cases of pneumococcic pneumonia is about 20 per cent.

Although the pneumococcic pneumonia may have been superimposed on a primary atypical pneumonia, there has been a striking response in these patients to specific serum therapy and an increasing occurrence of sulfonamide-fast strains.

Since a differentiation between primary atypical pneumonia and atypical pneumococcic pneumonia is difficult on clinical grounds alone, a bacteriologic etiology must be ruled out carefully before denying the patient chemotherapy or specific serum treatment.

BENJAMIN COPLEMAN, M.D.

Primary Atypical Pneumonia of Unknown Cause. Robert C. Schmitz. *Arch. Int. Med.* 75: 222-232, April 1945.

This paper is essentially a review of the literature on atypical pneumonia and carries a comprehensive bibliography.

Ingestion of Kerosene Complicated by Pneumonia, Pneumothorax, Pneumopericardium, and Subcutaneous Emphysema. Arnold F. Lavenstein. *J. Pediat.* 26: 395-400, April 1945.

The author presents a case of pneumonia, pneumothorax, pneumopericardium, and subcutaneous emphysema following ingestion of kerosene. This is similar to a case reported by Scott (*J. Pediat.* 25: 31, 1944. *Abst. in Radiology* 44: 307, 1945).

Benign Pneumoconiosis. Eugene P. Pendergrass and Simon S. Leopold. *J. A. M. A.* 127: 701-705, March 24, 1945.

Benign non-specific pneumoconiosis, as the name implies, is that condition in the lungs resulting from the inhalation of organic or inorganic dusts which, while they may be retained, are neither toxic, allergenic, nor pathogenic. Although they may be capable of producing an insignificant amount of reactive fibrosis, this never progresses to true nodulation. Unlike free silica and asbestos, these dusts produce no symptoms, no disability, and no predisposition to tuberculosis—only shadows on the roentgenogram. In this group are included baritosis, which has been seen in the baryta miners in Italy and in a few workers in Pennsylvania, and the siderosis of electric arc welders. In baritosis the lungs are studded with small sharply circumscribed nodules which in the experimental animal have been

found to be due to collections of mineral dust, with no evidence of fibrous tissue overgrowth. There are no associated respiratory symptoms. Various authors have described the roentgen appearance in electric arc welders as a "fine nodulation" and as "simulating pre-nodular fibrosis."

To this group of benign pneumoconioses the authors add 4 cases of siderosis in metal grinders. The roentgen findings were similar in all respects to those in electric arc welders. Silicosis was excluded in these cases.

It is impossible to differentiate the roentgen appearance of nodulation of silicosis or the pseudo-nodulation of benign pneumoconiosis from the shadows cast by many pulmonary diseases unassociated with the inhalation of dust. The diagnosis of the pulmonary lesions in such circumstances depends on the collaboration of the internist, the roentgenologist, and the laboratory technician. To differentiate between silicosis and benign pneumoconiosis one must have a detailed knowledge of the occupational history and environmental conditions of the worker and precise information regarding the nature, concentration, and particle size of the dust to which he is exposed.

Advanced silicosis is usually disabling and, when complicated by tuberculosis, it is fatal. Advanced asbestosis produces disability and ultimately may induce death from cardiac failure. Benign pneumoconiosis produces nothing but shadows on a roentgenogram. It is therefore of greatest importance to the worker, to labor, and to industry that these conditions be distinguished.

Iron Oxide Dust and the Lungs of Silver Finishers. A. I. G. McLaughlin, J. L. A. Grout, H. J. Barrie, and H. E. Harding. *Lancet* 1: 337-341, March 17, 1945.

Three silver finishers or polishers who had been exposed to the dusts of iron oxide and silver were examined clinically and roentgenographically in 1936. One of these men, who had worked as a silver finisher for forty years, died in 1943, after an operation for gastric ulcer. The lungs of this man were studied histologically, and chemical estimations of iron oxide and silver content were made. A fourth silver finisher was examined in 1938.

Little or no physical disability appears to be caused by the presence of iron oxide dust in the lungs, though in one case there was emphysema. The first three men were requested to report for examination because of the nature of their work and not because of any complaint of ill health. All had slight coughs. The fourth man complained of gastric symptoms of fifteen years' duration but had no symptoms or signs pointing to a chest condition. A chest film was taken only because of a family history of pulmonary tuberculosis.

X-ray examination of the chest revealed stippled or reticulated shadows in each of the four cases, the picture resembling that found in welders, in hematite miners, and in other workers who inhale iron and iron oxide dust. In silver finishers and in welders the individual shadows appear to be related in size and distribution to the aggregates of iron oxide dust found in the peribronchial and periarterial lymph spaces. The density of the shadows is apparently proportional to the amount of iron oxide dust present and also the anatomic weight of iron. No fibrotic changes (either collagenous or reticular) are set up in the lungs by the inhaled dust, which consists mainly of pure iron oxide. In cases of silicosis, the x-ray shadows are in the main not attrib-

table to the presence of opaque dust, but probably to the amount of fibrotic tissue and congestion present in the lungs.

In the interpretation of chest roentgenograms of workers in dusty occupations, consideration should be given both to the activity of the dusts in producing pathological changes and to the opacity of the chest on x-rays.

The term "siderosis" was applied by Zenker to what he regarded as a pathological condition of the lungs caused by long-continued inhalation of the dust of iron or iron oxide. This term carries with it an implication that iron or its oxides causes fibrosis of the lungs. The authors believe that a clear distinction should be made between siderosis and sidero-fibrosis.

Observations on Pulmonary Disease in Graphite Workers. Lasar Dunner. *Brit. J. Radiol.* 18: 11-12, February 1945.

Five patients were observed with pulmonary disease after industrial exposure to pure graphite dust for seventeen, eighteen, twenty, and thirty years. The changes demonstrable roentgenographically were nodular and coalescent fibrosis, similar to silicosis. There were some alterations in percussion and auscultation, but the physical signs were not in proportion to the changes seen on x-ray examination. Symptoms were minimal, consisting of cough with sputum. No tuberculosis was found.

SYDNEY J. HAWLEY, M.D.

Serial Roentgenograms of the Chest in Periarthritis Nodosa as an Aid to Diagnosis. A. Elkeles. *Notes on the Pathology of the Pulmonary Lesions.* L. E. Glynn. *Brit. J. Radiol.* 17: 368-373, December 1944.

Because of the diversity and changing character of the signs and symptoms, only a few of the 400 cases of periarthritis nodosa reported in the literature have been diagnosed during life. The common signs are intermittent fever, tachycardia, polyneuritis, polyarthralgia, albuminuria, cylindruria, asthma, bronchitis, and leukocytosis of 15,000-20,000, often with a high percentage of eosinophils. Occasionally there are redness in the skin up to 1 cm. in diameter. Hemorrhagic cutaneous lesions are sometimes present. Biopsy of the skin nodules will show the typical vascular lesions.

The most widely accepted etiologic theory attributes the disease to an extreme degree of vascular allergy.

Involvement of the lungs has been reported rarely, and few x-ray examinations of the chest have therefore been recorded. The radiological signs may, however, be pronounced, even though the physical signs are slight, and serial examinations especially may be of diagnostic value. The signs are: enlargement of the hilar shadows, mottling appearing in the middle and lower lung fields, patchy infiltrations, and in the late stages an enlarged pulmonary conus, enlarged pleural spaces, and pleural effusion.

Five cases are reported.

SYDNEY J. HAWLEY, M.D.

Roentgenographical Pulmonary Changes in Periarthritis Nodosa. Tore Svanberg. *Acta radiol.* 26: 312, March 31, 1945. (In English.)

To the rather scanty literature on periarthritis nodosa in the lungs the author adds 3 cases, in 2 males

male, 58, 56, and 53 years of age, respectively. Roentgen examination revealed increased vascular markings, rather coarse centrally but thinning peripherally, with interspersed irregular areas of infiltration. In one case the changes were predominantly on the right side, while in the others they were evenly distributed over both lungs. F. ELLINGER, M.D.

Löffler's Syndrome—Eosinophilic Pneumonia. Case report. Sidney Scherlis. Mil. Surgeon 96: 349-354, April 1945.

A case of Löffler's syndrome in a 24-year-old soldier reported. Roentgenograms on the second day of the illness showed diffuse soft changes throughout the extent of both lung fields. Films taken nine days later showed complete clearing.

Blast Injury to the Lungs: Clinical and Radiological Findings and Their Relation to Certain Symptoms. Fearnley. Brit. M. J. 1: 474-477, April 7, 1945. The author presents a review of 21 cases of blast injury of the lungs with an initial comment on the pathology of this condition, i.e. hemorrhage due to capillary rupture. In the cases discussed, though the clinical picture was clear enough, the individual symptoms and radiological findings varied considerably. The usual case there was unconsciousness followed by dyspnea or a "blown up" sensation with retrosternal muscular pain, cough, hemoptysis, and epistaxis. Physical signs were not remarkable. The x-ray findings in most instances consisted of dense shadows on the right or left base, suggesting fluid. The shadows were not specific and had not the patchy appearance of pneumonia. There was no relation between the severity of symptoms and the appearance of the chest film. Treatment was symptomatic. Q. B. CORAY, M.D.

Pulmonary Concussion. ("Blast") in Non-Thoracic Wounds. Oswald Savage. Lancet 1: 424-429, April 7, 1945.

In a series of 87 autopsies on battle casualties, the majority with penetrating head wounds, 30 instances of "blast" changes in the lungs were discovered. In none of these had there been external evidence of thoracic damage, and clinical signs of pulmonary abnormality had been remarkably sparse. In no case did hemoptysis occur. The pulse rates had been only slightly raised, and the blood pressures were within normal limits, but in many instances there was some respiratory distress with labored breathing. Physical signs in the chest were minimal and confined to adventitious sounds scattered over the lung, but more pronounced at the base. In later cases, when routine chest films were taken in patients who might have been exposed to blast, typical radiological changes, consisting of a diffuse, rather "fluffy" mottling, were sometimes observed. It was found constantly at autopsy that the hemorrhages were more widespread than the ante-mortem pictures suggested. Such an x-ray appearance is caused not only by blast hemorrhages but is consistent with scattered bronchopneumonia, silicosis, and other conditions.

At autopsy, the lungs were large and in the majority of cases the surfaces showed no change, but on sectioning a "spatter" of hemorrhages was seen. In some cases these had coalesced to form areas of consolidation, especially in the lower lobes and frequently only in the anterior costophrenic fringes. Circular areas of hemorrhage about 1 cm. in diameter were scattered through-

out the lung. They were darker in the more consolidated center, with a brighter red and ill-defined edge fading off into the normally colored lung. To obtain a record of the distribution of the hemorrhages, many of the lungs were reinflated and studied roentgenographically. Two types of pictures were seen. One showed scattered opacities, sometimes confined to one lobe; in the other, not only were scattered opacities present but in parts the hemorrhages were so numerous that an appearance of consolidation was produced. In these latter areas the larger bronchioles were patent.

In the 30 cases, evidence of blast hemorrhage elsewhere in the body was seen 10 times. The liver was found bruised in 6 patients. Hemorrhages on the surface of the heart were seen 4 times. Small areas of hemorrhage were seen in the pancreas, spleen, and colon, each on one occasion. In every case where an abdominal organ was implicated, there was bleeding into the retroperitoneal tissues.

In 9 of the 30 cases with pulmonary changes the blast was assessed as severe, in 10 as moderate, and in 11 as slight. In 10 per cent of the 87 cases, therefore, it was considered that blast lung played a considerable part in causing death and in another 10 per cent a small part. Bronchopneumonia occurred in 4 of the moderate cases but in none of the severe cases. Sulfadiazine, given to prevent cranial sepsis, may have helped prevent this complication, also.

Primary Bronchiogenic Carcinoma. Alton Ochsner, J. Leonard Dixon, and Michael DeBakey. Dis. of Chest 11: 97-127, March-April 1945.

Primary bronchiogenic carcinoma has become one of the most frequent and important primary malignant lesions. Its incidence is increasing both relatively and absolutely. It occurs predominantly in males, and largely in the sixth and seventh decades. The authors attribute the growing incidence chiefly to the increase in smoking and the inhalation of tobacco smoke, and support this view by references to the literature.

Pulmonary carcinoma is almost entirely a disease of the bronchi, although rarely it may begin in the alveoli. Most bronchiogenic carcinomas are located in the region of the hilus, and the right side is more frequently involved than the left. The tumor is usually slow growing and remains localized for a long period. Metastasis takes place (a) by direct extension, (b) through the bronchial lumen, (c) by implantation (biopsy or operation), and (d) through the blood and lymph streams; the sites most frequently involved are the regional bronchial and mediastinal lymph nodes (in about 70 per cent of the cases). Because of this, surgery offers a fairly good prognosis.

There is no characteristic clinical picture. The most frequent symptoms are cough, loss of weight, previous respiratory infection, hemoptysis, dyspnea, and pain in the chest. The physical findings vary with the location and extent of involvement. Every respiratory disturbance in a patient past forty, which cannot be explained, should be investigated with the possibility of primary bronchiogenic carcinoma in mind. Roentgen examinations are important, though in early cases they may show nothing. The film may show a shadow produced by the tumor itself, by metastatic mediastinal nodes, or by an area of atelectasis. Occasionally a small peripheral tumor not large enough to cast a shadow will give rise to a large mediastinal mass which may be interpreted as a primary lesion. The most reli-

able method for diagnosis is bronchoscopy and biopsy. Bronchography is also a valuable diagnostic method, especially when the mass casts no shadow and cannot be visualized by bronchoscopy. In suspected cases, expectorated material should be examined microscopically for tumor cells; also, a pleural effusion when present. Aspiration biopsy is condemned.

The only curative treatment of pulmonary carcinoma is surgical removal of the involved lung. Irradiation has little or no curative value; it may, however, produce palliation and should be reserved for inoperable cases and those in which surgery is definitely contraindicated.

The authors quote extensively from the literature and present graphically their own observations. They have performed 52 pneumonectomies and report 22 patients still living, 4 for five years or longer.

HENRY K. TAYLOR, M.D.

Difficulties in the Differential Diagnosis of Bronchogenic Carcinoma. Robert G. Bloch, William E. Adams, Thomas F. Thornton, and J. Edmond Bryant. *J. Thoracic Surg.* 14: 83-97, April 1945.

Six cases are presented in some detail to illustrate the difficulties in the differential diagnosis of bronchiogenic carcinoma. Many roentgenograms are reproduced showing the roentgen problems. The authors advocate routine chest roentgen examinations in all hospital and clinic admissions. They believe, however, that the final diagnosis can never be established by roentgen methods and that, if bronchoscopy fails, surgical exploration is the only reliable diagnostic procedure. Early lesions are illustrated, closely simulating tuberculosis, lung abscess, and pneumonia. Clinical findings are not of decisive value, especially in the early cases.

HAROLD O. PETERSON, M.D.

Hamartoma (Often Called Chondroma) of the Lung. John R. McDonald, Stuart W. Harrington, and O. Theron Clagett. *J. Thoracic Surg.* 14: 128-143, April 1945.

The term hamartoma was coined in 1904 by Albrecht, who stated that "hamartomata are tumor-like malformations in which occurs only an abnormal mixing of the normal components of the organ. The abnormality may take the form of a change in quantity, arrangement, or degree of differentiation, or may comprise all three." The word hamartoma is derived from a term which means to fail or err.

Previously reported hamartomata in the lung were made up chiefly of cartilage and have therefore been called chondromas. Since these tumors have many and occasionally all the elements of the adult bronchus, it is felt they should not be regarded as true teratomas, especially since they are not found in the mediastinum. They are frequently subpleural in the lung, and the small ones simulate a Ghon complex roentgenologically. The size varies, and the masses are usually lobulated and well circumscribed. The tumors are all benign.

The authors had 23 cases available for study. In 3 of these the tumor was removed surgically, and in 20 the lesion was discovered at necropsy. These 20 cases were found in a series of 7,972 necropsies.

Only occasionally are symptoms produced by these tumors. They can be found by roentgen studies, but a final diagnosis can be made only by histological ex-

amination. Surgical removal is advocated if there is some contraindication. In the experience with lung tumors they have found one which approximates the pathological appearance of hamartoma.

HAROLD O. PETERSON, M.D.

Case of Besnier-Boeck-Schaumann Syndrome. Benign Lymphogranulomatosis, with Tuberculous James Isbister. *M. J. Australia* 1: 275-277, May 1945.

The author reports a case of bilateral pulmonary nodules occurring in a patient with sarcoidosis. The diagnosis of sarcoidosis was made on the basis of the roentgenographic appearance of the lungs, roentgenologic bony involvement, an increase in total serum calcium content, a negative Mantoux test, and failure to find tubercle bacilli. No peripheral lymphadenopathy was present and there were no skin lesions; hence no material was available.

The patient, a female 19 years old, was first seen in December 1940 complaining of loss of weight and of insomnia, progressing over a period of six months. The temperature was 101° F., but there were no other abnormal physical findings. Roentgen examination revealed extensive discrete nodules throughout both lungs, of productive type, suggestive of pulmonary tuberculosis. Blood examination revealed nothing unusual except for a shift to the left on the Arneeth count. No tubercle bacilli were found in the sputum on two examinations. Gradual improvement occurred during the next year and serial examinations revealed a progressive resolution of the pulmonary lesions.

In January 1943, the patient enlisted in the Australian Auxiliary Air Force. Her general health was good and a photofluorograph of her chest with 10 mm. film was passed as normal. She was admitted to an Air Force Hospital in October 1943 because of dyspnea on exertion and pain in the left chest. Roentgen examination showed a partial pneumothorax on the left, causing displacement of the heart, and also mottling or "marbling" of both lungs, particularly toward the basal regions. No tubercle bacilli were found in 6 specimens of sputum or in the fasting gastric contents. Radiographic examination of the feet revealed a small cystic area in the head of the metatarsal bone and another at the base of the proximal phalanx of the 2d digit of the same foot. The blood serum protein content was 8.5 gm., of which the albumin fraction was 6.2 gm. and the globulin 2.3 gm. per 100 c.c. After two weeks rest in bed the left lung had fully expanded. Six weeks later a spontaneous pneumothorax occurred; this also responded to rest in bed, and the patient was well at the time of the present report, with no other clinical manifestations of disease.

The pathology, prognosis, and treatment of the disease are briefly discussed. Histologically the picture is one of a granulomatous lesion, and the picture is not a usual feature. In healing, the sarcoid either resolves and disappears completely or is replaced by fibrous tissue. It is therefore difficult to explain the occurrence of pneumothorax in the reported case. A possible explanation is obstruction of a terminal bronchiole with alveolar emphysema leading to rupture into the pleural cavity, or the presence of necrosis of a subpleural focus. H. H. WRIGHT, M.D.

"criber Heart" in a Tuberculous Patient. Jason Barber and D. K. Miller. *Am. Rev. Tuberc.* 51: 320, April 1945.

"criber heart" is characterized by dilatation of the associated with signs of cardiac failure, a normal accelerated circulation rate, electrocardiographic changes, and a response to specific vitamin therapy (niacin). There may be evidence of other B-vitamin deficiencies which simplifies the diagnosis.

This case is reported in which pulmonary tuberculosis appeared to be the precipitating factor. The patient had been bedridden for months, his appetite had been poor, and he had had a mild peripheral neuritis of the lower extremities. An acute cardiovascular syndrome developed, characterized by left ventricular failure and pronounced cardiac dilatation. There was no response to digitalis but after treatment with thiamine and niacin, improvement was rapid. Death occurred three months later from tuberculosis. L. W. PAUL, M.D.

Cardiac Hypertrophy and Extramedullary Erythrocytosis in Newborn Infants of Prediabetic Mothers. Albert C. Miller. *Am. J. M. Sc.* 209: 447-455, April 1945.

Infants born of diabetic mothers sometimes have atypical cardiac hypertrophy, extramedullary erythrocytosis, adrenal hyperplasia, increased eosinophilia of the anterior hypophysis, and hyperplasia of the female genital organs, as well as increased body weight and hyperplasia of the islands of Langerhans. The diagnosis of this syndrome in infants born to mothers who have not yet developed diabetes is of importance not only in directing the care of the infant in the neonatal period, but also in anticipating the onset of diabetes in the mother.

In the 7 cases reported, no mother had any symptoms of diabetes before or during the pregnancy in question, and only one had glycosuria. Signs and symptoms developed in the mothers from two days to five years following the birth of the infant. In all but one instance, the onset of diabetes was gradual.

Five of the infants died. At least one of the abnormalities noted above was present in each case. Although the findings are the same in the infants whether or not maternal hyperglycemia has been established, the absence of diabetic symptoms and signs in the mothers makes the diagnosis of the syndrome in the children more difficult. This difficulty can be partly overcome by anticipating the presence of the syndrome in infants with an excessive birth weight and with cardiorespiratory symptoms. The routine use of roentgen studies of the heart and normoblast counts when the birth weight is 4,500 gm. or more, and when cyanotic spells, dyspnea, and tachypnea occur during the neonatal period, regardless of birth weight, will greatly aid in establishing the diagnosis. Since the heart size diminishes rapidly and the normoblasts disappear from the peripheral blood relatively early, both studies could be initiated the first or second day after birth.

The size of the heart returns to normal in the first or second month of life, and the cardiorespiratory symptoms, when present, do not persist beyond the first ten days of life, in contrast to the findings in infants with congenital malformations of the heart or its great vessels.

An excessive normoblastemia may be associated with toxemia, syphilis, and premature birth. Erythroblastosis

fetalis may make the differential diagnosis difficult, but anemia or jaundice is usually present in that condition.

BENJAMIN COPLEMAN, M.D.

Radiographic Examination of a Case of Cancer of the Thymus. Axel Renander. *Acta radiol.* 26: 297-301, March 31, 1945. (In German.)

This case report concerns a male patient 75 years of age. The radiographic symptoms differed somewhat from those given by previous authors. The diagnosis of cancer of the thymus was corroborated by autopsy.

F. ELLINGER, M.D.

THE DIGESTIVE SYSTEM

A New X-Ray Method of Studying the Anatomy and Motility of the Stomach and Duodenum: Its Diagnostic Value. Walter Farkas Gruber. *Am. J. Digest. Dis.* 12: 127-137, April 1945.

The stomach is divided by radiologists and clinicians into three parts, the fundus, the corpus or body, and the pars pylorica. The fundus is divided from the body by an imaginary straight line drawn from the lower end of the esophagus to the greater curvature, while the body of the stomach is divided from the pars pylorica by an imaginary line drawn from the incisura angularis to the greater curvature.

In order to study the anatomy of the stomach and its behavior under the influence of local mechanical stimuli, the author took balloons of different sizes, attached them to buckles of Rehfuß tubes and inserted them into the fasting stomach. He filled them with varied amounts of air and, after giving the patient barium, studied the behavior of the stomach by means of roentgenograms.

It was found that the stomach could be divided into the three parts mentioned above, which as functional units are connected with each other anatomically as well as physiologically. These parts could be further subdivided into segments. It was also proved that a rhythmic segmentation exists in the stomach as in the intestines. The subdivision of the body of the stomach and pars pylorica was shown by transverse folds as well as by different phases of dilatation and contraction.

In observing the stomach radiologically, one must take into consideration that it is not only part of a transport system but also a chemical plant and its muscles must contract powerfully around ingested food so that it may exert its chemical function.

When barium is ingested, the stomach reveals only the changes that are characteristic of its function as a transport system. If, however, a balloon is inflated in the pars pylorica, the effect is the same as if solid food were ingested, and haustral segmentation appears. By inserting a balloon and filling it with 30 c.c. of air, the author was able to produce a systolic contraction of the entire pars pylorica. It not only became narrower but shorter, proving that both the circular and longitudinal muscles contracted at the same time.

When a balloon was inserted into the fundus and body of the stomach and filled with air, the muscles of the pars pylorica relaxed in proportion to the amount of air introduced until they reached a state of inertia. When the duodenum was distended by a small balloon the sphincter contracted and the pars pylorica and body of the stomach relaxed.

The oblique muscle, which is continuous with the

circular muscle of the esophagus, forms a sling around either side of the lesser curvature. The author observed contraction of this muscle when the balloon was located beneath the incisura angularis and inflated and when it was inflated in the body of the stomach. When the oblique muscle relaxed, the longitudinal muscle contracted. The circular muscle was seen to contract and form sphincter-like areas.

The author has studied the human stomach in 44 cases by means of balloons filled with air. Several cases are recorded in which he was able to find gastric ulcer or carcinoma where it would otherwise have been difficult or impossible to detect.

JOSEPH T. DANZER, M.D.

An Experiment in the Early Diagnosis of Gastric Carcinoma. Fordyce B. St. John, Paul C. Swenson, and Harold D. Harvey. *Ann. Surg.* 119: 225-231, February 1944.

In an attempt to discover symptomless cases of gastric cancer, 2,432 persons were examined roentgenologically at Presbyterian Hospital, New York. Subjects of the study were persons over the age of fifty who had no significant digestive symptoms (visitors to the hospital and patients who had been treated for conditions other than gastric). So far as possible, persons were included who ordinarily would not have received a gastro-intestinal study. Four hundred and ninety-one of the series were re-examined, making a total of 2,923 examinations. Nineteen individuals with important gastric symptoms were admitted to the study in error and were deducted from the final tabulations.

The examination consisted of rapid fluoroscopy of the stomach. In the first thousand cases a single stomach film was also made, but as nothing was found on any of the films that had not been observed fluoroscopically, this practice was discontinued. The authors believe that an experienced roentgenologist rarely requires more than a minute to satisfy himself that he is dealing with a normal stomach. If the stomach appeared normal, the patient was dismissed. If any suggestion of abnormality was seen, he came back for further careful study at a later time. The examination was made in the erect position only, unless something suspicious was found in the fundus, in which case the patient was also examined prone.

Among the 2,432 cases, 3 unsuspected malignant gastric tumors (2 cancers, 1 lymphosarcoma) were encountered; so far as is known, no tumor was missed. The lymphosarcoma was manifested fluoroscopically as a persistent area of flattening near the pylorus. This was confirmed by further roentgen studies, but at operation the surgeon was unable to recognize any lesion, even with the stomach opened, and therefore did not resect. Some months later, at the site of the suspicious roentgen finding, an obvious tumor developed, which was then resected. The two carcinomas were very small and had not metastasized; both were resected.

Five other patients had gastric resections after extensive roentgenologic study and in most instances conservative therapy and gastroscopy, and were found to have only benign ulcers. These cases illustrate the difficulty in making an exact diagnosis in gastric lesions, even with all the diagnostic aids available.

Five hundred and twenty-eight abnormalities other than cancer were discovered, the greater percentage being functional. However, 54 instances of deformed duodenal bulb without symptoms of ulcer, 7 cases of

cardiospasm, and 25 cases of diaphragmatic hernia were found.

The cost of the examination was approximately 50 cents a person, but this does not include the roentgenologist's services or the overhead charges for roentgenologic equipment.

Intestinal Obstruction by Gall-Stones. *Med. Brit. M. J.* 1: 555-556, April 21, 1945.

The author points out that intestinal obstruction by a gallstone is rare but has the highest mortality of all intestinal obstructions. Reference is made to a series of 646 cases in which intestinal obstruction was the primary diagnosis. In only 49 of these was the condition due to a gallstone. The author reports a case of an 87-year-old man without significant gastrointestinal symptoms.

The fistulous opening is usually into the duodenum. The stone, a large one where obstructive symptoms occur, starts down the intestinal canal and becomes intermittently in the narrower places, at which time symptoms become apparent. The author points out that vomiting and abdominal pain continuing over a period of 24 hours may be considered evidence of a serious condition. The x-ray is helpful in diagnosis in determining small intestinal stasis and gas; at times, the stone can be shown. The treatment is immediate surgery.

Q. B. COHEN, M.D.

Pathology of Regional Ileitis. G. W. H. Scott. *Am. J. Digest. Dis.* 12: 97-116, April 1945.

The author reports a case of regional ileitis and presents an elaborate study of the pathological aspects of this condition based on his own observations and a review of the literature. The disease has three components: (1) a *primary phase*, characterized by a stage of edema of the submucosa and serosa with dilatation of submucosal lymphatics and hyperplasia of juxtamuscular adventitial blood vessels; (2) a *stage of plasma-cell infiltration* of the submucosa and serosa; (3) a *diffuse fibrosis*, with disappearance of plasma cells, except where trapped; (4) a *healing phase*, characterized by ulceration and granulation tissue. The author suggests that the disease is imposed on any of the primary phases, with accompanying modification of the pathological process. There are tendencies to early or late perforation, fistula formation, and granuloma formation.

A critical analysis of possible etiological factors suggests that the primary disturbance is either a direct acute injury of the bowel wall by a metabolic, toxic, or lipid in character, or results from a neuropathic disturbance involving Auerbach's and/or Meissner's plexuses, or mesenteric and celiac ganglia. In the author's opinion, the original neuropathic lesion is possibly a type of visceral herpes zoster. It is suggested that the type of secondary ulceration occurs only when the primary lesions are destructive as well as irritative, leading to denervation of the affected bowel wall.

On the Reduction of Ileal-Ileocolic Intussusception by Means of Contrast Enema. E. Dahl-Jensen and Børge Fogh. *Acta radiol.* 26: 293-296, March 1945. (In English.)

In the experience of the authors, reduction of ileocolic intussusception by means of contrast enema is only exceptionally accomplished. They cite a series of 28 cases of intussusception in the ileocecal region, of which 11 proved to be irreducible by contrast enema.

the latter group were found at operation to be ileal-intussusceptions, while the 19 cases which were shown roentgenographically to be ileo-

A case is also reported in an infant of three hrs which was irreducible by enema as far as the anal portion of the ileal segment was concerned. In case the intussusception into the small intestine is demonstrable radiographically.

Referring to reported examples of conservative reduction of ileal-ileocecal intussusception, the authors state that they cannot accept such a diagnosis until an unmistakable demonstration is given of the intussusception before complete reduction.

F. ELLINGER, M.D.

ABDOMINAL INJURIES

Radiology of War Injuries. Part 1. War Wounds of the Abdomen. D. B. McGrigor and Eric Samuel. *J. Radiol.* 18: 65-75, March 1945.

A analysis of 25,000 war casualties showed 12 per cent of the injuries to be abdominal. Of this group, 80 per cent were penetrating wounds, with a 70 per cent recovery rate. The recovery rate for non-penetrating wounds was 90 per cent. Two per cent of the casualties involved both the thorax and abdomen, and in this group there were 50 per cent recoveries.

Radiological examination can be of assistance in detecting foreign bodies, indicating the track of missiles, the possibility of damage to the viscera, and demonstrating the presence of pneumoperitoneum, associated wounds of the chest, extraperitoneal injuries (ruptured spleen), and postoperative obstructions. Examinations of wounds of the upper abdomen should include the chest and those for wounds of the buttocks and the thighs should include the lower abdomen.

A supine film, including the diaphragm, a lateral film, and an erect film (with the patient sitting if he cannot stand), or, if this is not possible, a horizontal anteroposterior film with the patient lying on his side, should be made in each case.

Stab wounds were comparatively unusual in World War II, the majority of perforating wounds being due to missiles. These were caused chiefly by fragments of shells, mortars, and bombs, and the abdominal injuries thus produced carried a far more serious prognosis than bullet wounds. Fragments of the light alloy casing of incendiary bombs may go no further than the abdominal wall, but the symptoms (guarding, rigidity, tenderness) may closely simulate intra-abdominal injury. In such cases careful study of the roentgen film may prevent unnecessary laparotomy. Anatomical structures, as indriven ribs, may also act as missiles, causing severe visceral damage, and fractures of the pelvic girdle may involve the peritoneal cavity.

While the clinical diagnosis of penetrating abdominal wounds is usually obvious, radiology, as pointed out above, will often furnish valuable aid. The radiographic appearances depend upon the relative extent to which solid and hollow viscera are involved. Among the roentgen features listed by the authors are: pneumoperitoneum, which, however, is seldom seen on films taken within twelve hours of a penetrating injury; distention of the bowel above the site of injury, while the bowel below is empty; retroperitoneal hematoma demonstrable as a large soft-tissue mass displacing the gas-filled bowel.

Estimation of the missile track by observation of the

wounds of entrance and exit may be useful, but it is to be borne in mind that the intervening course may be extremely tortuous. Nor should too much reliance be placed on demonstration of a foreign body, to the neglect of other evidences of injury.

Abdomino-thoracic wounds may be classified as (a) injuries caused by separate missiles, (b) missiles entering the thorax and emerging from the abdomen and the reverse, (c) transverse wounds of the chest involving the diaphragm and the upper abdominal organs, and (d) tangential wounds of the lower chest with indriving of the ribs. Wounds of the chest at or below the nipple may involve the diaphragm and abdominal structures. The possibility of diaphragmatic hernia must always be borne in mind.

Non-perforating injuries may involve either a hollow viscus or a solid organ, injuries to the spleen being the most common. Radiology finds its chief application in cases of doubtful diagnosis, in which the operative indications are not clear. Films should be examined for free gas in the peritoneum, abnormal collections of gas in the bowel, retroperitoneal hematomata, and renal injuries.

The results of blast injuries, though more common in the skull and chest, are also observed in the abdomen. Multiple intra-intestinal and intraperitoneal hemorrhages have been observed, and the radiologic appearance may be that of paralytic ileus. Immersion blast injuries are also discussed.

Postoperative ileus and obstruction are common after abdominal wounds. Their character and degree are best estimated by radiography.

The author quotes extensively from the literature and includes a bibliography and numerous roentgenograms with brief case histories. SYDNEY J. HAWLEY, M.D.

THE MUSCULOSKELETAL SYSTEM

Sclerosing Sarcoma of Bone. (Dangers of Biopsy.) James F. Brailsford. *Brit. J. Radiol.* 18: 8-10, January 1945.

Sclerosing sarcoma of bone occurs most commonly at about the age of twenty. The radiographic appearance is typical, showing sclerosis of bone with or without radiating spicules of new bone formation. In this type of sarcoma prompt amputation gives the best results.

Biopsy is not advisable, as it is frequently misleading, showing no evidence of sarcoma. It weakens the stability of the bone; it does not assist in predicting metastasis, and it may disseminate tumor cells, thus adding to the risk to the patient. Three illustrative cases are presented. SYDNEY J. HAWLEY, M.D.

Renal Osteodystrophy. Report of a Case of Unusual Pathogenesis. John J. Castronuovo. *Arch. Pediat.* 62: 156-166, April 1945.

The author chooses the term renal osteodystrophy to designate cases of osseous disorder associated with renal insufficiency. In the literature such cases have been termed, also, renal rickets, renal dwarfism, and renal osteitis fibrosa cystica.

The renal lesions show evidence either of embryologic maldevelopment or of long-standing infection with insufficiency. Some of the genito-urinary lesions reported have been: hypoplasia with cyst formation, congenital polycystic disease, congenital valves of the urethra, ureteral strictures, and glomerulonephritis. Hypertrophy of the parathyroids seems to have been a

rather constant finding and is considered to be secondary to the renal insufficiency.

The bone lesions correspond in general to those of osteitis fibrosa cystica. In addition to these, one finds in children changes suggestive of those seen in rickets, as knob-like swellings at the epiphyses, knock-knee, bent wrists and ankles.

Acidosis is common; the phosphorus level is usually somewhat elevated (4-16 mg.); the calcium is normal or decreased. The calcium phosphorus ratio is somewhat less than normal.

The author gives in detail a case history, but does not show any reproduction of x-ray films. It is the opinion of the abstractor that the average roentgenologist would rather see one typical film than to read many uncounted words of analytical discussion, however scholarly.

PERCY J. DELANO, M.D.

Diseases of the Vertebral Column: A Roentgenologic Analysis. Albert Oppenheimer. *Am. J. Roentgenol.* 53: 348-369, April 1945.

The diseases of the spine may be regarded as vertebral localization of bone and joint disease and can be classified as (1) diseases of vertebral bone; (2) diseases of vertebral symphyses; (3) diseases of vertebral synovial joints; (4) diseases of vertebral ligaments. In general, the morphological appearances and clinical manifestations of a given vertebral disease correspond to those of the same disease involving other bones and joints. Under the above classification, the author describes and illustrates many of the diseases as they involve the vertebral structures. Thus, tuberculosis is primarily a necrosing lesion in the vertebra, as elsewhere. Owing to its cancellous structure and abundant blood supply, the vertebral body is involved more frequently than the neural arch, and this is true in other diseases as well. Lesions of the vertebral symphyses may have their origin either in the bone or in the disk. Bone disease close to the horizontal vertebral surface leads to involvement of the disk mainly by interference with disk nutrition.

The various types of arthritis occur in the apophyseal joints and their roentgen and clinical manifestations are the same here as in other true joints.

Of the lesions of the vertebral ligaments, only calcification and ossification are disclosed roentgenologically. These are common reactions and not characteristic of any particular disease and are apparently the result mainly of disuse of the ligaments. L. W. PAUL, M.D.

Uncovertebral Osteophytes and Osteochondrosis of the Cervical Spine. Ernst Lyon. *J. Bone & Joint Surg.* 27: 248-253, April 1945.

This paper deals with the observation of 40 patients showing localized hypertrophic lesions peculiar to the cervical spine and first thoracic vertebral body, which the author terms "uncovertebral osteophytes." Uncovertebral osteophytes occur at the lateral and posterolateral lips of the vertebrae, on their superior surfaces. Normally these surfaces are concave, with elevated lateral margins known as processus uncinati. The osteophytic change occurring in these processes is degenerative in nature. It is thought that interference with the spinal nerves may be the cause of the syndrome, consisting in neuralgic pains in the arms, neck, and back of the head.

Osteochondrosis is characterized by a degenerative, destructive process of the intervertebral disk as a

whole, with fibrillation, dehydration, and fissuring, resulting in marginal bone proliferation of the lips of the cervical bodies.

Roentgenologically there are decrease in height of or several of the lower vertebral bodies and narrowing of the intervertebral spaces. There are also uncovertebral bone lipping of one or several uncovertebral processes, and marginal proliferations on the inferior face of the body above that affected. Oblique views are necessary to demonstrate the uncovertebral osteophytes.

JOHN B. McANENY, M.D.

Myelography by the Use of Pantopaque in the Diagnosis of Herniations of the Intervertebral Disks. Arthur B. Soule, Jr., Sidney W. Gross, and James C. Irving. *Am. J. Roentgenol.* 53: 319-340, April 1945.

Pantopaque, a recently introduced contrast medium for myelography, has been used by the authors in 100 cases. The technic for introduction and removal of the substance is essentially the same as that described by Kubik and Hampton for lipiodol (*New England J. Med.* 224: 455, 1941. *Abst. in Radiology* 37: 654, 1941). Pantopaque has certain advantages over other media. It flows more readily than lipiodol, can be easily moved by slight changes in the position of the patient, tends to outline the nerve root sheaths and mix with cerebrospinal fluid better. Because of its low viscosity, it is easily injected and withdrawn. In most of the cases the majority of the pantopaque was removed following completion of the roentgenographic examination. No untoward effects were noted in any of the patients; removal was not complete.

The various types of defects encountered in lumbar and cervical disk herniations are described and illustrated. Pantopaque has been of particular value in the diagnosis of herniation of the cervical intervertebral disks. By proper manipulation of the patient, it can be pooled in the cervical area and it shows less tendency to break up into globules than lipiodol.

L. W. PAUL, M.D.

Observations on Opaque Myelography of Lumbar Disc Herniations. D. C. Eaglesham. *Brit. J. Radiol.* 17: 343-348, November 1944.

For demonstration of herniated disks in the lumbar region, the opaque medium (lipiodol or pantopaque) should be injected in the interspace between L2 and L3 or L3 and L4, as most herniations are found at L4 or below. To avoid an extradural injection, 1 c.c. may be injected and a brief fluoroscopic examination made. If the oil moves freely the full injection may then be carried out. In most instances 3 c.c. is adequate, but 5 to 6 c.c. are preferable.

Removal of the oil may be easy or difficult. In patients with flat spines a small pillow may be placed under the chest and hips to increase the curvature. This will assist in collecting the oil in a dependent position. If the needle is placed too superficially, the oil will not be recovered. Sometimes rotating the patient a few degrees to one side or the other will be helpful.

Four types of defects are observed in the oil column: displacement, indentation, block, and lack of filling of the axillary pouch or nerve root sheath.

Indentation of the column is the commonest. It may be unilateral or bilateral. The size of the indentation may change with change of position.

Displacement is rare, occurring only with large herniations with deep indentation or some degree of block.

the presence of block the oil may be pinched up a point or there may be an abrupt transverse termination of the column. The block in the column is times seen well above the disk space level.

Block of filling of the nerve sheaths may be due to protrusion of the disk but it may also occur normally. Usually it is associated with deformity of the oil column. If the nerve sheaths not seen on the first examination may still be seen at later examinations if the oil is not reabsorbed.

The deformities caused by extradural and subdural calcifications may lead to errors in diagnosis. Another source of confusion appears when the spinal fluid flows into the subdural space producing a long narrowing of the column. SYDNEY J. HAWLEY, M.D.

Lateral Prolapse of the Cervical Intervertebral Disc. H. Davies. *Brit. J. Radiol.* 18: 1-4, January 1945. Lateral herniation of the nucleus pulposus in the lateral region may cause pain by pressure on the nerve roots. Such herniation is often associated with malalignment and loss of joint space.

Four cases are reported in which the chief complaint was pain in the shoulder radiating down the arm. Roentgenography (with pantopaque) showed lateral filling defects, indicating lateral herniation of the disks. In two of the cases no abnormality was evident on the roentgen film.

In these cases show a spontaneous tendency to recovery, surgery is not advised. Head traction and a supporting collar may give relief.

SYDNEY J. HAWLEY, M.D.

Congenital Absence of the Pectoralis Major. Eric Muel. *Brit. J. Radiol.* 18: 20-21, January 1945.

Congenital absence of the pectoralis major on one side may give rise to confusion if the radiologist does not make a physical examination. This is particularly so to occur in mass surveys. The roentgen appearance is that of an abnormal translucency of the upper half of one hemithorax which may be interpreted as physema. Two cases are presented.

SYDNEY J. HAWLEY, M.D.

Arachnodactyly (Spider Fingers). H. Gray. *Arch. Surg.* 75: 215-221, April 1945.

A case of arachnodactyly, or spider fingers, in a ten-year-old boy with congenital dislocation of the lenses and a congenital cardiac peculiarity, is presented. The physical build of this patient was carefully studied by means of anthropologic measurements and the data compared with the normal and with other cases of arachnodactyly recorded in the literature. [Since the publication of this paper an interesting account of arachnodactyly occurring in a father and two daughters appeared in *RADIOLOGY* (Parker and Hare: *Radiology* 45: 220, September 1945).]

Calcification of the Tendon Cuff of the Shoulder. J. Beckett Howorth. *Surg., Gynec. & Obst.* 80: 7-345, April 1945.

One hundred cases of calcareous degeneration in the tendon cuff of the shoulder are reviewed, and the symptoms, signs, roentgenographic appearances, and etiologic factors are considered. Twenty-three of these cases were treated surgically and their pathology is discussed. The results of treatment by surgical and non-surgical procedures are reported.

The tendon cuff is composed of the tendons of the subscapularis, supraspinatus, infraspinatus, and teres minor muscles, which fuse with the capsule of the shoulder joint about an inch from its distal margin. Calcareous degeneration in this tendon cuff is a frequent and disabling lesion and a common cause of so-called subdeltoid bursitis. Calcareous deposits were found in the bursa itself in only one of the cases reported. The symptoms, signs, and roentgenographic features of the lesion are considered characteristic. The degeneration in the tendon cuff is probably due to attrition from the use of the arm at the side, with repeated, sudden, jerky movements.

The calcareous material found in the tendon cuff is suspended in liquid in the early acute cases, and the roentgenographic shadow is "cumulus cloud-like" and fairly homogeneous. The deposit is granular and infiltrating in the chronic cases, and the shadow is fragmented and irregular in outline and density. Roentgenograms should be made in 45 degrees internal and 45 and 90 degrees external rotation, as well as in the neutral position, since a single view may fail to show one or more of the calcifications.

Relief from pain and spasm, and absorption of the suspended calcareous material may often be obtained in the early acute cases by rest, heat, diathermy, cold, ethyl chloride spray, or radiotherapy. The chronic cases are not likely to be helped by such measures. Repeated or intensive radiotherapy is undesirable, as it may increase the degeneration or damage the overlying skin. Massage, stretching, and manipulation are likely to increase the pain, spasm, and limitation of motion, and to damage the shoulder. Rupture of the calcareous deposit into the bursa spontaneously, or with treatment, will give immediate relief. Aspiration, irrigation, or puncture may relieve pain through drainage and reduction of tension. Novocain injection relieves pain only temporarily unless the calcareous material is drained at the same time. Operative removal of the calcareous material is the surest and quickest method of relief, particularly in the chronic cases. Complete removal of the deposit is desirable for the best results. Special exercises should be used with any of the treatments, for preservation of strength and restoration of motion in the shoulder and arm.

R. E. BOOTH, M.D.

The Internal Epicondylar Epiphysis and Elbow Injuries. Adolf A. Schmier. *Surg., Gynec. & Obst.* 80: 416-421, April 1945.

Fracture dislocations of the elbow in children are frequently accompanied by displacement of the internal epicondyle into the joint. Recognition of such displacement is of the first importance if a well functioning elbow is to be insured. For this purpose, detailed roentgenograms made in various positions are essential.

In early cases both the dislocation and the epicondylar displacement are easily reduced by the closed method described by the author. This is based on the fact that the internal humeral epicondyle gives origin to a group of muscles which pronate the forearm, flex the wrist and fingers, and aid in flexing the elbow. The procedure consists in turning the forearm in supination and extending the elbow, wrist, and fingers. At the same time, the forearm is gently abducted, thus increasing the gap between the trochlea and ulna and allowing the epicondyle a free route of exit from the joint. In late cases, adhesions will bind the displaced

epicondyle to the joint and open reduction will be necessary. The possibility of some loss of motion in this event is strong.

The degree of damage in these cases varies with the severity of the trauma. In the least serious cases the epicondyle is only slightly separated. When the trauma is more severe, the epicondylar epiphysis may be pulled down to below the articular level of the elbow by flexor muscle pull. The internal lateral ligament may be strained or torn. With greater valgus strain, it is possible for the elbow to open momentarily on its medial aspect so that the epicondyle becomes wedged in the joint between the trochlea and the sigmoid fossa of the ulna.

The author reports 5 cases. All but one of these was successfully treated within twenty-four hours of the injury by the closed method. One patient was first seen three weeks after injury, when it was too late to attempt closed reduction, and open operation was required; intra-articular changes precluded a satisfactory result.

FRANCISCO BASSOLS, M.D.

GYNECOLOGY AND OBSTETRICS

Radiographic Manifestation of Tuberculous Salpingitis. Wolfgang Magnusson. *Acta radiol.* 26: 265-278, March 31, 1945. (In German.)

Salpingograms of 12 patients suffering from tuberculous salpingitis, verified by histologic examination after surgical removal of the tubes, have been compared with 200 salpingograms obtained from patients suffering from tubal occlusion from other causes. It has been observed that finely indented and ragged contours, defects of the lumen the size of a grain of rice or smaller, and fistula-like dilatations are evidence of tuberculous. On the basis of these manifestations tuberculous salpingitis can be diagnosed radiographically in the majority of cases.

F. ELLINGER, M.D.

THE GENITO-URINARY TRACT

Excretory Cysto-Urethrograms. John W. Draper and Joseph G. Siceluff. *J. Urol.* 53: 539-544, April 1945.

The authors present a method of studying the anatomy of the bladder and urethra and the physiology of micturition. In their particular technique, five separate roentgenograms of the lower urinary tract are made. The patient voids and is placed in the supine position on a tilt table. He is catheterized and the residual urine is measured. The bladder is distended with 120-180 c.c. of air until the patient notes distention, when a clamp is put on the catheter. An air cystogram is then made in the oblique position. The air is then evacuated and is replaced with a contrast medium, usually 15-20 per cent Skiodan, until the patient has a normal desire to urinate, at which time a roentgenogram is made in the oblique position with the patient voiding contrast medium. The patient is next asked to stop voiding and a roentgenogram is made as he contracts the sphincter muscles. He is instructed to void again, and a fourth exposure is made during voiding against the obstruction produced by a penis clamp. Following this the patient is allowed to empty his bladder, and a final film is exposed to demonstrate any opaque material which may remain.

Some excellent illustrations achieved by this method are included, showing inflammatory and traumatic strictures of the urethra, diverticula of the bladder, and incompetent sphincters.

R. E. BOOTH, M.D.

THE BLOOD VESSELS

Clinical Anatomy of the Vertebral Veins. March Norgore. *Surgery* 17: 606-615, April 1945.

The various explanations offered for the spread of so-called "paradoxical metastasis" have, until recently, been unsatisfactory. How, the author asks, do metastases reach the cervical spine from carcinoma of the prostate without deposits in the lung, or carcinoma of the breast metastasize to the spine without lymphatic involvement?

The rediscovery of the vertebral vein system by Batson (see *Ann. Surg.* 112: 138, 1940) demonstrated clearly the connection between this system and other venous systems and offers a plausible explanation for such metastatic spread. The author repeated Batson's experiments, injecting the dorsal vein of the penis in 3 cadavers, with Wehr's artist's water-color vermilion. In 4 of the specimens serial x-rays of the body showed that the injected mass flowed through the veins along the pelvic girdle as far distant as the head of the femur, along the vertebral column, and finally inside the cranium, without entering the vena cava. In the fifth the material entered the vena cava and did not proceed to the spinal column.

The transportation of cancer cells or a bacterial embolus against the usual direction of the blood stream, as in the invasion of the cranium by a bronchogenic carcinoma, is explained by a reversal of flow in the vertebral system of veins, which was shown to occur under certain circumstances, as sneezing, coughing, or straining. The absence of valves in the spinal veins is also an important factor, as it enables the blood to pass in either direction and consequently greatly increases the freedom of circulation.

The author concludes that there is a fourth system of veins, namely, the vertebral or meningeoarchival system, in addition to the caval, portal and pulmonary systems, through which tumor cells or infected emboli are sometimes spread to distant parts, and that this system of veins furnishes an anatomic explanation for so-called "paradoxical metastasis."

J. E. WHITELEATHER, M.D.

Arteriography for the Demonstration of Intracranial Aneurysms. Robert M. Lowman and Simon D. D. *Am. J. Roentgenol.* 53: 341-347, April 1945.

The clinical diagnosis of intracranial aneurysm is difficult and, in the past, most of these lesions have been discovered during operations for other intracranial conditions. The introduction of cerebral arteriography by Egas Moniz in 1927 (see *Rev. d'oto-neuro-ophth.* 11: 746-748, 1933) opened a new approach and since then many cases have been diagnosed by this method.

The authors have employed cerebral arteriography in 15 cases. Because of possible dangers from the use of thorotrast, a 50 per cent solution of diodrast is recommended as the contrast agent. Fifteen cubic centimeters of this solution is injected into the internal carotid after surgical exposure of the vessel. Within approximately three-quarters of the material has been injected, the first film is exposed and a series of 12

or four exposures is obtained as rapidly as the cassettes can be changed. A case of an aneurysm of the internal carotid is reported in which cerebral arteriography gave valuable diagnostic evidence. L. W. PAUL, M.D.

Peripheral Aneurysm of the Pulmonary Artery. Arne Clausen. *Acta radiol.* 26: 324-327, March 31, 1945. (In German.)

A case is reported, in a woman of 69 years, of an aneurysm in the pulmonary artery perforating into the bronchus of the lingual lobe. On the roentgenogram the aneurysm is seen as a rounded isolated area of rarefaction in the pulmonary parenchyma. An autopsy report is included. F. ELLINGER, M.D.

A Method for Determining the Blood Pressure in the Pulmonary Artery. Nils Westermark. *Acta radiol.* 26: 302-306, March 1945. (In English.)

By taking a series of roentgenograms of the lungs in various projections and with varying intrabronchial pressure, checked by a water manometer, the main branches and the stem of the pulmonary artery are found to be compressed at a given pressure for each individual tested. This pressure corresponds to the blood pressure in the pulmonary artery, in healthy persons being 25-30 mm. Hg. In patients suffering from mitral lesions the pressure was found to be augmented. F. ELLINGER, M.D.

Arteriography in Renal and Abdominal Conditions. O. A. Nelson. *J. Urol.* 53: 521-530, April 1945.

The author describes the technique of arteriography of the abdominal organs by aortic injection and reports his experience in 106 cases. A pressure apparatus is used for injecting the solution through an 18-gauge needle 12 cm. long. The x-ray unit must have the potential power to deliver 500 ma. and the Bucky diaphragm speed to permit an exposure of 0.25 sec. The contrast medium used is an 80 per cent solution of sodium iodide.

By way of preparation the patient is given 60 c.c. of castor oil in 90 or 120 c.c. of root beer the afternoon before the examination and allowed only liquid nourishment thereafter. The solution is placed in a glass tube and the pressure brought up to 1.5 atmospheres. A scout film of the abdomen in the supine position is made. Under sodium pentothal anesthesia, the needle is introduced just below the twelfth rib and three or four fingers' breadth to the left of the spinous processes. The point of the needle is directed inward and downward toward the twelfth vertebral body and when the bone is encountered the point is deviated laterally so as to glide over the vertebra. The stylet is then withdrawn and the needle advanced slowly a few centimeters to enter the aorta. After blood comes through the needle, it is advanced another 0.5 cm. and the pressure apparatus is attached. The outlet valve is opened and 6 or 8 c.c. of contrast solution is allowed to run in, the exposure being made just as the injection is completed. The pressure apparatus is then disconnected and after a few cubic centimeters of blood runs out the needle is withdrawn. By using a lead shield over the Bucky diaphragm two films may be exposed at two- or three-second intervals.

Three hazards are described: acute iodism, which is combated by an intravenous infusion of 1,000 c.c. of 5 per cent glucose in normal saline with 200 units of

vitamin C after the patient has been returned to bed; extra-aortic injection of contrast media, and extravasation through the needle puncture. Extra-aortic injection caused pain but the hypertonic solution is absorbed in a short time. Owing to the ruggedness of the aortic wall, perforation with an 18-gauge needle does not cause leakage.

Diodrast, 70 per cent, and skiodan were tried and failed to afford clear delineation of the smaller arteries but did produce dense shadows of the renal parenchyma. Forty cubic centimeters of diodrast, 70 per cent, injected into the aorta will produce satisfactory urograms in patients with inadequate renal function to permit visualization by intravenous injection.

The use of arteriography is described in the location of organs, arterial obstruction, aneurysm, and renal neoplasms which cannot be detected on pyelograms. Five arteriograms are presented showing a retroperitoneal tumor, obstruction of the renal artery, an aneurysm of the abdominal aorta, and two cases of renal neoplasms undetected on pyelograms.

The importance of training in the dissecting room before attempting aortic puncture on patients is emphasized, and the need for study and experience in interpretation of arteriograms is noted. Properly performed, the author believes that aortic puncture should carry no more hazard than a spinal puncture or a cystoscopy. FRANK P. BROOKS, M.D.

GAS GANGRENE

X-Rays in Diagnosis and Localisation of Gas-Gangrene. F. H. Kemp. *Lancet* 1: 332-336, March 17, 1945.

During the last war a number of observers noted that it was possible to detect gas in the tissues by means of x-rays, but this in itself is not enough for the diagnosis of gas gangrene, since there are several other conditions which give rise to gas in the soft tissues.

Any fresh wound, even a tiny needle puncture, may permit air to enter the tissues. Sometimes gas crepitation may be detected clinically, or bubbles may be seen in the depths of the wound, but in most cases roentgenography is necessary. On the roentgenogram the air appears as radiotranslucent bubbles, pockets, or streaks in the soft tissues. It is seldom confined to the track of the wound, but is widely dispersed in the surrounding loose cellular spaces. It may extend throughout the entire length of a limb, but it never infiltrates the muscles unless it is forced in under pressure.

The amount and distribution of air in the tissues vary according to whether the wound is open or closed, and with the amount of tissue loss. In civilian casualties air in the tissues is seldom detected, because the roentgenogram is usually taken to show the bones, and definition of the soft parts is obscured or lost in the blacker parts of the negative. A still more important reason is that the injured part is usually put at rest by efficient first-aid, thus preventing movements, active or passive, which tend to suck air into the tissues. Air may be seen in any muscular wound which communicates with the respiratory passage. Once the injured part is placed completely at rest, air is quickly absorbed. In twenty-four hours the amount has diminished considerably, and within three days all but a trace is gone.

Air can be introduced by changing a pack, removing a stitch, or by irrigation. In one case it was introduced during the manipulation of an intramuscular penicillin drip. Soft paraffin gauze tends to impair the absorption of air and holds it in pockets on the skin or in the wound. Thus the treatment adopted must be considered when assessing the significance of gas bubbles in the tissues.

Local formation of gas in the depths of a wound by gas-forming organisms gives roentgen appearances which closely resemble those given by air, and differentiation is usually impossible except by serial roentgen examinations, and even then the observer must be acquainted with all the details of the treatment subsequent to the accident. Local gas formation does not necessarily mean invasion of the living tissues by organisms for, as a rule, bubbles form in a hematoma, around a foreign body, or in dead tissue. In such cases there may be no clinical signs of infection and the roentgen signs do not in themselves demand surgical intervention.

True gas gangrene is a progressive infiltration of muscles and the loose cellular tissues with gas-forming organisms. As the infection spreads through living tissues, there develops a severe toxemia which, if allowed to continue, brings about the death of the patient.

In the heavier parts of the body it is easy to miss one or many gas bubbles in a single anteroposterior projection. To avoid mistakes the greatest care must be taken to examine the patient clinically and rotate the limb or position the tube so that the suspected part is uppermost. A projection taken from the side is probably the most important. In experiments on a human cadaver, it was found that as much as 3 c.c. of air in the muscles of the thigh might escape detection in a single anteroposterior roentgenogram, but lateral projections showed bubbles as small as 0.25 c.c.

Anyone who has studied soft-tissue films of the injured should be aware of the normal relative translucencies between the main groups of muscles; these are due to fat. In some patients, especially old or middle-aged persons with flabby muscles, the roentgenograms show multiple linear streaks in the muscles which are due to fatty replacement; this picture at first glance may resemble the appearance of acute fulminating gas gangrene but, if care is taken to examine the whole limb, it will be seen that the change is not confined to any one group of muscles and bears no relationship to the clinical signs. A film of the opposite limb for comparison is of assistance.

After an injury, there are often local collections of free fat in the loose cellular spaces around the injured part. This fat is revealed as radiotranslucent patches or streaks in the tissues. As a rule, the translucency is not so great as that produced by gas, but at times it is difficult to detect a difference. Bubbles almost always mean gas, but streaks or irregular translucent patches may be due to gas or fat. In serial films, the air is found to disappear quickly, whereas fat may persist for several days. If there is a fatty accumulation in a joint, i.e., a lipohemarthrosis, the fat tends to rise to the surface to form a top layer and a lateral view taken from the side shows a fluid level; this picture resembles air in the joint. In fat people, especially in the region of the buttock, roentgenography may reveal many linear streaks in a bruised muscle which are due to fat; these resemble the earliest stages of gas infiltration of a muscle and cannot be distinguished by a single roentgen examination.

It is difficult to decide when gas-forming organisms

have begun to invade the loose cellular tissues. The fact that a wound is dirty, inflamed, and foul smelling means only that inflammatory reaction is taking place. Gas crackling in the subcutaneous tissues or bubbling from the depths of the wound is not necessarily due to gas-forming organisms, for it may be merely air. Even the presence of anaerobic bacteria means nothing beyond the fact that the wound is infected, and many wounds so infected show no trace of gas. Anaerobic cellulitis almost always accompanies true gas gangrene, and gas formation in the loose cellular tissues can often be detected roentgenographically in advance of an infection of the muscles, with little clinical evidence of its presence except when the gas is subcutaneous.

The most important fact which radiology establishes is that gas in the tissues does not necessarily indicate anaerobic infection of the wound, and that in the majority of cases the gas is really air. These points are easily appreciated if there are no clinical signs of infection but easily overlooked if there is any cause for anxiety. When a surgeon discloses discolored and friable muscles in a wound which is two or three days old, it may seem very suspicious to find bubbles of gas, but if there are no signs of invasion of the healthy tissues, it is almost certainly safe to do no more than resect the damaged tissues. A doubtful case should be kept under constant clinical and roentgenographic observation.

In every accident case admitted to a hospital, roentgen examination should be done at least once, preferably as soon as possible after admission. Every patient who complains of increasing local pain or discomfort in the tissues around his wound should be re-examined. Three hourly examinations are usually sufficient, but in some instances, where the clinical course changes rapidly, it may be necessary to examine the patient every hour.

Seven cases of gas gangrene are reported. In 2, there was an acute fulminating infection of living tissues. In both, the vascular supply to the part was not seriously impaired, the development of the infection was extremely rapid, the toxemia profound, and within a few hours of the recognition of the disease the patients were dead. The roentgen findings in the other 5 cases bore no strict relationship to the degree of toxemia. In 2 cases, the x-ray pictures were almost identical and the distribution of gas was similar; yet one patient was desperately ill while the other was only slightly toxic. In the one case the infection had spread from the dead to the living tissues and toxic absorption could readily take place, whereas in the other the infection was minimal. In 2 cases, amputation of the limb was necessary because part of it was already dead; the anaerobic infection of the muscles in these cases would have been important if operation had been delayed and the infection had spread to the living tissues. Two cases illustrate the importance of repeated examinations of a dead limb while waiting for a line of demarcation; in both of these cases the development of anaerobic infection in the dead tissues precipitated operation, for both patients were beginning to show signs of toxemia.

Roentgenograms are reproduced.

TECHNIC

Automatic Exposure Control in Photofluorography. Russell H. Morgan. *Dis. of Chest* 11: 150-155, March-April 1945.

Photofluorographic examination of the chest is greatly facilitated by the introduction into the x-ray

circuit of a photoelectric timing mechanism, or phototimer, which replaces the conventional timing device. The mechanism consists of a multiplier phototube and a condenser-thyratron-relay system. This device is capable of terminating the x-ray exposure when a sufficient quantity of radiation has reached the screen. The phototube is a camera device located in the hood and focused on a cross-wise area of the middle and adjacent upper portion of the screen. During the exposure, the rays from the screen are not only focused on the fluorographic camera, but also on the timing device. As a result of a sufficient quantity of radiation on the screen, a current is set up and conducted by the phototube. The magnitude of the current is proportional to the intensity of the fluorescent radiation. This current is collected by a condenser, whose potential increases as a result of collected charges. At a given potential, the thyratron becomes conductive and permits a current to pass through the field coils of a relay. This opens the relay contacts and terminates the x-ray exposure.

The predetermined density or radiation effect is controlled by the operator. Exposures are either short or long, depending upon the brilliance of the fluorescent screen. Optimum diagnostic quality is obtainable by adjusting the sensitivity of the phototube, the size of the condenser, and the potential at which the thyratron becomes active.

Practically, the machine is set at the beginning of the day (at 90 kv., 500 ma., for example). Thereafter, the technician places the patient, closes the x-ray switch, and the phototimer automatically controls the exposure. This eliminates measuring the thickness of patients and adjusting the machine with every exposure. It makes for uniform results, reduces to insignificant proportions

the number of retakes, and reduces personnel operating photofluorographic units by 50 per cent.

[Morgan and Hodges published an evaluation of automatic exposure control in *RADIOLOGY* for December 1945 (Vol. 45, p. 588).] HENRY K. TAYLOR, M.D.

Tomography. J. B. McDougall. *Edinburgh M. J.* 52: 127-131, March-April 1945.

The author believes that tomography is a valuable supplement to routine radiological and fluoroscopic examination in the diagnosis and interpretation of pulmonary lesions. The apparatus and technique are described.

A Simple Apparatus for Body Section Radiography. Percival A. Robin. *Mil. Surgeon* 96: 273-275, March 1945.

An easily constructed and inexpensive device for obtaining body section roentgenograms is described. This apparatus consists of three parts, adapted to fit the Keleket W-2 table and 6A tube stand; minor changes in construction, however, permit adaptation to any standard equipment. The principles of operation are given, together with certain technical factors.

Diagnostic Use of Radioactive Common Salt. Gunnar Sohrne. *Acta radiol.* 26: 279-285, March 31, 1945. (In English.)

A method for the study of the circulation in different vascular regions by the use of radioactive sodium chloride and a Geiger-Müller counter is described. The method appeared particularly useful in the diagnosis of brain tumors, for determining whether or not the tumor is vascular. F. ELLINGER, M.D.

RADIOTHERAPY

NEOPLASTIC DISEASE

Radium Treatment of Cancer of the Oesophagus. M. Lederman and J. Clarkson. *Brit. J. Radiol.* 18: 22-28, January 1945.

This paper is based in part on the contribution of Lederman to a Discussion on the Treatment of Carcinoma of the Oesophagus before the Royal Society of Medicine (Proc. Roy. Soc. Med. 37: 331, 1944. Abst. in *Radiology* 44: 103, 1945). The indications for treatment of pharyngo-esophageal tumors, mid-esophageal tumors, and cardio-esophageal tumors are repeated here and a fairly detailed account of the method of introducing the radium bougie for tumors in the mid-esophagus is included. This requires a meticulous technique. The site and location of the tumor must be accurately determined. The lumen of the esophagus must be adequate to take a 28 French catheter, as smaller sizes do not allow as good dose distribution. The bougie must fill the whole length of the esophagus, as otherwise it tends to be displaced upward. The tubes should have a linear density of 10 mg./cm. A divided dose is employed, the bougie being inserted on alternate days and shifted in position to equalize the distribution of the dose.

Of 15 patients with pharyngo-esophageal cancer, 3 were alive and symptom-free after one year. Of 38 with mid-esophageal tumor, 1 lived two and one-half years and the remainder died within six months. Of 15 with cardio-esophageal cancer, 1 was alive after

five years and 1 survived one year and five months but died with the disease. In commenting on the results in mid-esophageal cancer the author points out that survival figures do not give the true picture, since "the rapidity with which the symptoms are relieved, and the avoidance of gastrostomy, are of incalculable value to the patient." SYDNEY J. HAWLEY, M.D.

Results of Irradiation of Ovarian Tumors. H. Dabney Kerr and Robert A. J. Einstein. *Am. J. Roentgenol.* 53: 376-384, April 1945.

The results of combined surgical and roentgen treatment of 100 consecutive patients with carcinoma of the ovary, diagnosed clinically or pathologically, are reported. The cases are tabulated according to age distribution, clinical grouping, pathologic diagnosis, radiation dosage, and survival rates. The majority of the patients received a tumor dose of more than 2,000 r. No relationship was found between the tumor dose and the rate of survival. From the authors' experience and that of others, as found in the literature, there seems to be a definite relationship between the clinical stage of the disease and the rate of survival. It is generally agreed that postoperative irradiation results in a definite improvement in the five-year survival rate. This improvement is most noticeable in those groups in which total removal of all primary and metastatic tumor tissue was impossible, in recurrent tumors and in those entirely inoperable when first seen.

It is concluded that irradiation should be given in all cases of malignant ovarian tumor, but only after the removal of as much neoplastic tissue as possible. Pre-operative irradiation is indicated only in advanced inoperable cases.

L. W. PAUL, M.D.

Electroendothermy as an Adjuvant to Radiotherapy in Uterine Cancer. S. Thorén. *Acta radiol.* 26: 249-264, March 31, 1945. (In English.)

The use of electrosurgery (fulguration) is suggested in the treatment of uterine cancer. The author reports 70 cases of cancer of the cervix and 3 cases of cancer of the corpus uteri treated at the Radiumhemmet in Stockholm and followed for at least four years. On the basis of this experience, electrosurgery appears particularly suitable in patients offering a poor surgical risk because of complicating disease and in cases where radiation therapy has failed, especially in those in which it is impossible to differentiate between a recurrence and radium necrosis. Eleven cases in which radiation therapy failed were cured by electrosurgery for at least four years.

F. ELLINGER, M.D.

Wilms' Tumor of the Kidney. Roy G. Giles, *Urol. & Cutan. Rev.* 49: 217-220, April 1945.

Four patients with Wilms' tumors were admitted to the Robert B. Green Memorial Hospital (San Antonio, Texas) within a five-year period. In 2 the disease was too far advanced for any form of treatment and in 1 case therapy was refused. One child lived twenty-three months following a combination of preoperative irradiation, surgery, and postoperative irradiation.

MAURICE D. SACHS, M.D.

Roentgentherapy of Hemangioma of the Larynx in Infants. H. H. Kasabach and C. P. Donlan. *J. Pediat.* 26: 374-378, April 1945.

Two cases of hemangioma of the larynx in infants, successfully treated by roentgen irradiation are presented. The symptoms of hemangioma of the larynx, in the order of frequency, are obstructive dyspnea, inspiratory stridor, a hoarse cry, croupy cough, blood-tinged mucus, gross hemorrhage and fever if there are pulmonary complications. In the differential diagnosis of laryngeal stridor in infants, one must consider other causes, such as a small glottic lumen, congenital web below the glottis, macroglossia, laryngeal papilloma or cyst, enlarged thymus, mediastinal tumor, and foreign body. In the presence of fever, perilaryngeal abscess and acute infections must be ruled out.

After the obstructive dyspnea has been relieved by a low tracheotomy, irradiation, either by radium or x-ray, may be started. The authors believe that if 1,200 r can be delivered to the site of the lesion, roentgen therapy is the treatment of choice because of its simplicity and accuracy of application. Should irradiation fail, surgical removal, preferably by thyrotomy, must be considered.

Eight other cases of hemangioma of the larynx in infants are tabulated.

Roentgen Therapy of Boeck's Sarcoid. Ernst A. Pohle, Lester W. Paul, and Elizabeth A. Clark. *Am. J. Med. Sc.* 209: 503-513, April 1945.

The cause of sarcoid and its relationship to tuberculosis remain in dispute. The lesions may involve

any organ or system in the body but show a predilection for the reticulo-endothelial system, especially the lymph nodes. The basic lesion is the epithelioid cell tubercle with occasional giant cells of the Langhans type, without caseation and only occasionally with some central necrosis. Because of the microscopic appearance, the diagnosis of hyperplastic or non-caseous tuberculosis is often made. The mediastinal lymph nodes and the pulmonary tissues are probably the most frequent sites of involvement.

The treatment of the disease has usually been empirical, including various drugs and such modalities as hyperpyrexia and irradiation by ultraviolet and roentgen and radium rays. The latter have been successful in the treatment of the skin lesions. While x-ray irradiation has in the past not proved beneficial, several recent reports have appeared which offer greater hope.

Eight cases (only 2 proved by biopsy) treated by the authors are reported in detail. Two of these were progressive for almost two years before roentgen therapy produced a favorable result. Objective evidence of regression appeared in from two to four months after therapy was instituted. It was preceded in nearly all cases by clinical improvement. Six treatments were given of 150 r (in air) to anterior and posterior mediastinal ports (15 X 20 cm.), one area being treated daily, (175 kv.; half-value layer 1.05 mm. Cu). This series of treatments was repeated in from six to eight weeks. Other nodes usually were given 3 X 150 r (in air), with treatments daily or every other day, the series being repeated once or twice at intervals of four to six weeks.

The therapeutic result was excellent in 1 case, good in 4 cases, satisfactory in 1 case, and fair in 2 cases. No untoward reactions were observed. The authors are therefore encouraged to make further trial of x-ray therapy and advocate its use by other radiologists.

BENJAMIN COLEMAN, M.D.

NON-NEOPLASTIC DISEASE

Tendogenetic Disease and Its Treatment with X-Rays. J. Borak. *New York State J. Med.* 45: 725-729, April 1, 1945.

In tendogenetic disease, of which so-called "frozen shoulder" is the most familiar example, the degeneration and necrosis of the tendon give rise to a peritendinitis of the surrounding sheath, which in turn may spread to other structures, as, in the case of the shoulder, the walls of the bursa subacromialis, the sheath of the tendon of the deltoid, and the fibrous layers of the joint capsule. In such cases, x-ray therapy is directed not to the necrotic tendon but to the inflammatory process in the tendon sheath, walls of the bursa, and neighboring structures.

This inflammatory process presumably starts as a simple serous exudate but usually goes on to a precipitation of fibrinogen, with strands of fibrin loosely binding together the walls of the bursa and adjacent structures. It is upon these fibrin strands that the x-rays act indirectly, through dilatation of the capillary walls and an increase in their permeability. This is followed by an increased flow of plasma from the blood, carrying along lymphocytes, monocytes, and leukocytes which have the power to phagocytize and to carry away the fibrin and the necrotic tissue debris.

Two varieties of tendogenetic disease are recognized—the calcified and non-calcified. For treatment purposes the author subdivides the cases with calcifica-

tion into three groups. (1) Cases with complete or nearly complete immobilization of the affected part (typical "frozen shoulder") respond to a dose even as small as 100 r, calculated at the bursa, given on two or three consecutive days, but it may be advisable to add 200 r on two successive days to prolong the duration of the post-irradiation edema and thus to increase the number of cells functioning as phagocytes. One portal of entrance is sufficient in these cases. Even very large deposits may then gradually disappear without further treatment. (2) In more chronic cases, with restricted mobility of the arm, a dose of 200 r, calculated at the bursa, is given six to eight times at intervals increasing from two to four days. Two portals of entrance, one anterior and one posterior, are required in these cases. After a month, a new series of treatments is added, if necessary, until the deposit is substantially reduced in size and density, and the pain on moving the arm has considerably subsided. (3) In the third group of cases pain is experienced only at the extremes of the range of motion, when the arm is raised over 80 degrees. For this chronically stationary condition, a dose of 250 r, calculated at the bursa, is given eight times at intervals of two days. Three portals of entrance, one anterior, one lateral, and one posterior, are required. After about six weeks, a new series of treatments is added in accordance with the course of the symptoms.

The non-calcified variety of the disease resembles clinically the calcified type and responds similarly to roentgen therapy. Tendogenetic disease elsewhere than in the shoulder calls for the same treatment. As in the case of the shoulder, the degree of impairment of motion is the main criterion of dosage.

Some Roentgenologic Considerations Pertaining to Upper Extremity Pain. Charles F. Behrens. J. A. M. A. 127: 888-890, April 7, 1945.

In this paper the author considers particularly symptoms referable to changes in the cervical vertebrae and thinning of the intervertebral disks consequent upon arthritic changes of degenerative hypertrophic type. Cervical arthritis has been found to be a fairly frequent cause of upper extremity pain. In the author's opinion either narrowing of the disk or productive changes significantly located may be factors in the mechanism of this condition. He suggests, in addition, that round-cell infiltration, passive congestion, and perhaps some degree of fibrosis—in other words, some degree of chronic inflammation—may often be more important than osteoid proliferation and thinning of the disks.

Diathermy and the usual methods of treatment have been found of little value in the treatment of these cases. Careful manipulation, traction, and massage produce much better results, and roentgen irradiation has proved one of the most effective methods of treatment. The action of the x-rays doubtless is on the irritated and congested soft tissues about the affected segments. Diminution of swelling and improvement of circulation reduce the pressure on the nerve roots, thereby relieving the pain. Any effect on the purely mechanical pressure from arthritic spurs or due to the thinned disks is not to be expected. Symptoms from disorders of the cervical vertebrae are often slower to respond to irradiation than those from the so-called subdeltoid bursitis. Changes in the roentgen appearance of the cervical lesions has been negligible in the author's experience.

Generally, 75 to 100 r, twice a week at first and later

weekly, are given (200 kv., 0.5 mm. Cu and 3 mm. Al filtration, 60 cm. distance). After six to eight treatments, a rest period of about six weeks is allowed, followed by a second course. Not all cases will be helped by roentgen therapy. Either extreme—giving up before an adequate amount of radiation has been administered (even up to 2,000 r in stubborn cases) or persisting unduly in the face of a poor response—must be avoided.

Roentgen Therapy as an Adjunct in the Management of Acute Postpartum Mastitis. Roger A. Harvey, Howard A. Spindler, and Andrew H. Dowdy. Surg., Gynec. & Obst. 80: 396-403, April 1945.

The authors report 100 cases of acute postpartum mastitis receiving roentgen therapy in addition to the usual conservative measures in 1942-1944. They compare the results to those in 15 cases treated by conservative methods alone during the same period and 77 cases similarly treated during the preceding sixteen years.

Among those who received roentgen therapy the duration of symptoms was 1.9 days; in the others, without suppuration, 8 days. The incidence of breast abscess in the irradiated group was 1.5 per cent and in the others, 20 per cent. The cost per infected breast among the hospitalized cases was \$17.22 at ward rates and \$27.50 at private rates for those not irradiated, exclusive of the attending physician's or surgeon's fee; in those who received roentgen therapy it was \$9.12 at ward and \$19.35 at private rates, including the radiologist's fee. Among ambulatory patients the cost to those treated with irradiation was \$4.60 ward and \$11.50 private rates.

Two types of initial infection were encountered; a superficial type following cracked nipples and abrasions and a deep or glandular type due to stasis within the ducts. After twenty-four to thirty-six hours most patients had a mixture of the two types.

The authors emphasize the importance of treatment early in the course of the disease and advise aspiration in cases which show any suggestion of suppuration after forty-eight hours. If no pus is obtained the patient is treated, but the chance of suppuration developing is 50 per cent. If pus is found, one or two preoperative treatments of 150 to 200 r each may be given. The authors do not believe in prophylactic irradiation in questionable cases. Two roentgen-resistant cases responded to sulfonamides.

The initial dose in the series varied from 40 to 100 r. Small doses were given to the more acutely ill patients. Those with small flat breasts or with a superficial type of infection only were treated at 120 kv., 10 ma., 3 mm. aluminum filtration, and 21.5 to 40 cm. target-skin distance. The other patients were treated at 200 kv., 25 ma., 0.5 mm. copper and 1.0 mm. aluminum filtration, and 50 cm. target-skin distance. The area treated included most of the breast and the lymphatic drainage related to the involved area. The time interval between treatments was usually twenty-four hours, but in cases in which the temperature continued to climb, another 50 r was given in the same day. One to 5 treatments were given per breast, with an average of 2.3. The total dose varied from 40 to 400 r, with an average of 165 r. Indications for more than one treatment included continued fever, residual pain and tenderness, and an elevated leukocyte count. Erythema was not a safe indication, as it might persist twenty-four to seventy-two hours after symptoms subsided. If there

was no response after thirty-six to forty-eight hours, roentgen therapy was discontinued.

Nursing from the infected breast was stopped during the acute phase, usually from six to eighteen hours. Breast pumping every eight hours was permitted except in cases with primary areolar or periareolar infections. After forty-eight hours without response, lactation was stopped in both breasts. Breast binders were used during the acute phase. Ice packs were applied during the early painful phase and local heat later. Salicylates were used for sedation.

Leukocyte counts were taken at the onset and daily thereafter. Many patients reached a crisis four to eight hours after treatment.

FRANK P. BROOKS, M.D.

Plastic Induration of the Penis. K. Schourup. *Acta radiol.* 26: 313-323, March 31, 1945. (In English.)

Of a series of 15 patients suffering from plastic induration of the penis, 12 were treated by roentgen irradiation (2 of these by irradiation and surgery) and 3 by surgery alone. The follow-up of the irradiated patients revealed 3 complete cures, 3 incomplete cures, and 4 failures. No follow-up was possible in 2 cases. Doses ranging from 100 to 250 r with 0.5 mm. Cu filtration were given in one exposure and repeated three times at intervals of two to eight days. This series was repeated, if necessary, after two to six months. The total dose usually amounted to 300 to 900 r.

F. ELLINGER, M.D.

TECHNIC AND DOSAGE

Standardisation of Technique in Radiotherapy. Emil Ungar. *Brit. J. Radiol.* 18: 76-84, March 1945.

Standardization of technic in radiation therapy is advantageous for purposes of more accurately determining both the surface and depth dose and distribution and for accurate reproduction of dosages in different patients. A standard technic should be as simple as possible to set up and should be capable of being applied to all patients with as little modification as possible.

Four standardized techniques are presented, intended to be used in treating lesions of the vertebrae, with full details. These techniques may be used in other parts of the body where similar relations obtain between the surface and the volume to be treated.

SYDNEY J. HAWLEY, M.D.

Dosage Rate in Radiotherapy. A Symposium. L. H. Gray, F. Ellis, G. C. Fairchild, and Edith Paterson. *Brit. J. Radiol.* 17: 327-342, November 1944.

The dose in radiotherapy is defined by Gray as a measure of the energy dissipated either as ionization, excitation, or heat per unit volume of tissue irradiated. In radium or x-ray therapy the dose in r, in most cases, is proportional to the total number of ions per unit volume. These ions are not distributed at random, but are found along the track of the ionizing electron. The immediate effects are therefore highly localized and there may be small regions of a cell which are not affected even by large doses.

The dosage rate is the rate at which one passage of an ionizing particle is followed by the next. If the interval is long enough, the cell may have the power to repair the damage done by one particle before the next transit. Therefore, the time interval between successive transits

rather than the dosage rate itself will determine the effect upon a given cell. Since radiation quality controls the number of particles crossing a volume of given size, the influence of dosage rate may sometimes be different for different qualities of x- and gamma-radiation. In such cases variation in dosage rate and quality will depth beneath the surface of the body may be irradiated quantities for a given primary beam of radiation.

Some biological factors may influence the effect of dosage rate. Thus, interrelated injuries may play a role. Since oxygen tension influences cell sensitivity, injury to the vascular structures early in the course of irradiation may influence the response of the malignant cells and thus alter the influence of dosage rate. Other variations in sensitivity, changing the proportions of cells in a relatively sensitive or insensitive state may affect the influence of dosage rate, as may the rate of intercurrent tissue growth and replacement and the rapidity of movement of body fluids.

Experimental attempts to determine the effect of dosage rate have failed to show consistent results. In experiments on the lethal effect on *Drosophila* eggs, the effect is apparently independent of the dosage rate between 5 and 120,000 r/m. Lethal effects upon *Aspergillus* spores and the decrease in growth rate of rice seedling roots showed no difference between 20 and 120,000 r/m. Studies on other biological materials showed decrease in effect at lower dosage levels. Most of these experiments suggest that there may be a "tolerance dosage rate" below which the particular effect will not be produced, no matter how long the exposure. However, some of the experiments indicate that the duration of the exposure is as much a factor as the dosage rate itself. These conflicting results may be explained as follows: An end effect of irradiation such as cell death can probably result from a variety of initial injuries, some of which are reversible and some irreversible, and each of which is produced in lethal amounts at a particular dose level. If the irreversible lethal injuries happen to be produced at the lowest dose levels, the effect will appear dosage-rate independent. If the reversible injuries are the more easily produced, then a dosage rate dependence will be observed up to the point where the total dose has reached the lethal level for one of the irreversible injuries, beyond which there will be no further increase in mean lethal dose however great the increase in dosage rate.

Thorough studies on gene mutation have shown no dosage rate dependence. Certain types of chromosomal injuries, however, are dependent upon dosage rate. Single break injuries are independent of fractionation and are proportional to the dose. "Exchange breaks," requiring the production of two breaks by separate ionizing particles, are markedly dosage-rate dependent.

The preponderance of evidence revealed with studies on biological material *in vivo* is that the effect of irradiation is not dependent upon dosage rate except at extremely low and extremely high rates. There are, however, as Ellis points out, certain advantages in the higher intensities from a practical point of view which indicate that a better end result may follow the use of higher dosage rates.

Fairchild's contribution to the symposium consisted of clinical observations on a variety of malignant lesions from which he deduces the following facts:

"(1) It is definite that various types of malignant tissue situated at various sites can be destroyed or

rendered inactive for periods up to five years by means of radiation applied at surface intensity up to 500 r/min. using radiation = H.A.V. 1.7 Cu and 2.05 Cu with single lesion doses of from 1,100 to 1,200 r.

"(2) It is definite that irradiation of a variety of deep-seated lesions at surface intensities up to 760 r/min. can destroy or render such lesions inactive over a period of five years when given in total surface doses of from 6,600 to 10,000 r in periods of from 7 to 12 days, using a radiation giving H.A.V. 2.05 mm. Cu.

"(3) It is definite that irradiation of normal tissues at intensities up to 500 r/min. does not cause a greater degree of damage than when given at intensity of the order of 20-40 r/min. as observed over a period of five years.

"(4) The fact that there are many advantages in being able to give a certain dose in one minute as opposed to 30, or even 15 minutes, must be self evident.

"(5) The systemic reaction following high intensity irradiation has been of a minor degree as compared with those following low intensity irradiation."

The closing contribution is that by Paterson, dealing with the effects on tissue cultures of prolonging the overall time of irradiation. Her experiments indicate "an improved effect following prolongation of time, and include a clarification of what may be the basis of this better effect—namely a greater uniformity of response in a group of irradiated cultures."

Since this symposium is more or less in the nature of an abstract itself, this review does not do it justice. Any one interested is urged to read the original.

SYDNEY J. HAWLEY, M.D.

Photographic Methods Applied to Dosimetric Problems. G. Spiegler. *Brit. J. Radiol.* 18: 36-44, February 1945.

A photometric method may be used for dosimetry in certain situations where ionization methods cannot be used. This involves conversion of the densities on the exposed film into corresponding dose values, with the aid of the so-called characteristic curve of the emulsion. To obtain the latter, an exposure is made through a rotating sector disk. When the disk, driven by a motor, revolves, the x-ray beam impresses on the film a sequence of stepped densities. The densities measured under each ring are then plotted against the log differences of the corresponding dose values. For purposes of photographic dosimetry, the picture of the field of treatment is traversed by the photometer, the readings plotted against distance; on the same film the exposure through the sector-wheel yields the relation of the blackening-values to dose-values. Since normal x-ray film is too sensitive for the purpose, a process film 150 times slower is used. The slower film is subject to much less error due to chemical fog.

The method is useful in measuring uneven fields and in constructing suitable equalizing filters in high-output, short-distance conditions, such as contact therapy; in measuring the leakage through defects in the housing of an x-ray tube or a radium unit; and in determining the stray radiation outside of a deep therapy cone.

SYDNEY J. HAWLEY, M.D.

Use of Radiographs for Dosage Control in Interstitial Gamma-Ray Therapy. W. J. Meredith and S. K. Stephenson. *Brit. J. Radiol.* 18: 86-91, March 1945.

Roentgenograms may be used to check the location of radium implants and also to check measurements made

clinically. Usually a pair of films made at right angles to each other, one of which parallels the plane of the implants, is adequate. With two plane implants, one view should "look between" the planes. Occasionally oblique views may be needed.

In order to obtain the actual dimensions of an implantation, the magnification must first be ascertained. This can usually best be accomplished by the ring method. An opaque ring of known diameter is affixed in the plane of the implant. One diameter of the ring will show no foreshortening, so this diameter can be used to determine the amount of magnification. Other methods of estimating the magnification are the geometric, the direct needle, and the indirect needle methods. The geometric method calculates the magnification from the target-film and the needle-film distances. The direct needle method uses one of the needles in the same manner as a ring. The indirect needle method is used when all show some magnification or foreshortening, one needle known to be in the correct plane being used as a guide to estimate the magnification. Illustrations of the use of each method are given.

Photographic checking in this manner also allows correction for grossly irregular implantation.

SYDNEY J. HAWLEY, M.D.

Behavior of Thimble Chambers When Used for the Measurement of Very Soft Radiation. J. A. Viortoren, Z. J. Atlee, and E. D. Trout. *Am. J. Roentgenol.* 53: 391-394, April 1945.

The trend toward lower inherent filtration by the use of beryllium windows in roentgen tubes has made necessary the study of the behavior of thimble chambers for very soft radiations. Such radiation has become available recently to the roentgen therapist in contact therapy apparatus. It was found that the standard Viortoren thimble chamber with red bakelite wall was not suitable for measurement of wave lengths much longer than 0.5 Angström effective and at 1.5 Angströms it read low by 50 per cent. An experimental beryllium wall thimble chamber is described with less wave length dependence, being only 10 per cent low at 1.5 Angströms.

L. W. PAUL, M.D.

EFFECTS OF RADIATION

Development of Sarcoma in Bone Subjected to Roentgen or Radium Irradiation. C. Howard Hatcher. *J. Bone & Joint Surg.* 27: 179-195, April 1945.

The experimental background of bone sarcoma following irradiation and the clinical literature are reviewed. Reports of 24 cases of bone sarcoma following irradiation were found. Curiously, in 17 of these cases roentgen therapy had been given for tuberculous arthritis, and in 1 for acute arthritis. The remaining 6 patients were exposed to radium; evidently these patients ingested or received injections of radioactive elements.

Three case reports are presented.

Case I is that of a male with a diagnosis of giant-cell tumor of the proximal epiphysis of the tibia, which was excised, with extensive postoperative x-ray therapy. The microscopic diagnosis was benign chondroblastoma. Six years later a mass in the same location was diagnosed as primary sarcoma in the proximal fibula and on amputation was found to be chondrosarcoma.

Case II is that of a female who had received an unknown amount of radium and x-ray treatment for a

giant-cell tumor of the distal right radius, followed in three years by surgical removal of the distal radius and operative correction of the deformity, seven years after the original diagnosis. No evidence of malignancy was found. Eleven years after the original diagnosis, the distal ulna showed a growth, which was excised and found to be a fibrosarcoma with tumor cartilage.

In Case III a mass developed at the anterior end of the right seventh rib, twelve years after a right mastectomy followed by irradiation. Excision proved the mass to be a chondrosarcoma.

In discussing the cases, the author admits the possibility of recurrence or metastasis, but is firmly convinced that the malignant changes were attributable to irradiation. Surgery is absolved, although it also was used in all cases. [Much can be said against the possibility of irradiation as the cause of the malignant change in all these cases.] JOHN B. MCANENY, M.D.

Changes in the Uterus after Eradication of Endometrial Adenocarcinoma by Radiotherapy, with Particular Reference to an Infarct-Like Radionecrotic Plaque in the Lining. John F. Sheehan, Herbert E. Schmitz, and Janet Towne. *Arch. Path.* 39: 237-256, April 1945.

A thorough gross and microscopic study was made of 4 uteri excised after eradication of carcinoma of the endometrium by large doses of radium (about 6,000 mg. hr.) and of roentgen radiation (about 4,000 r in the mid-pelvis). Routine sections of 2 other irradiated uteri were also studied. A carcinoma of the endometrium in one of these was destroyed by radiation. The changes are described in detail. The original site of the carcinoma in 5 of the 6 uteri could not be determined.

A localized plaque-like area of radionecrosis, essentially an area of coagulation necrosis, was found in the lining at or near the level of the internal os in 5 of the uteri. This was believed in every instance to be due to radium radiations. Changes were produced in the plaque by hemorrhage and infection. Whether or not such plaques are true infarcts is a question.

In the myometrial tissues adjacent to the uterine plaque, two zones showing the effects of radiation were found: a superficial zone of hyalinization and edema with necrobiotic changes and a deeper zone of edema with atrophic changes. In the cervix a single zone of hyalinization was the usual finding. Vascular changes were seen in these zones but were not confined to them.

Other observations included some degree of chronic endometritis, chronic cervicitis, and endometrial atrophy; chronic metritis, mild and more or less focal, and other non-specific lesions, including squamous metaplasia of the endometrial epithelium in one case.

Treatment of Post-Irradiational Ulcers by Radon Ointment. A. G. S. Cooper and D. F. Robertson. *M. J. Australia* 1: 297-300, March 24, 1945.

The treatment of post-irradiation necrotic ulcers by radon-impregnated vaseline as outlined by Uhlmann was adopted at the Brisbane General Hospital early in 1943. Results have been good in all cases except ulcers due to gross overdosage. The treatment has also proved effective in x-ray dermatitis and varicose ulcers and in chronic ulceration occurring in thermal burns and keloids.

Radionecrotic ulcers are divided into two types, immediate and delayed. The immediate ulcer usually follows overdosage or an orthodox dose of radiation in the presence of debilitating disease, restricted blood supply, or sepsis. The delayed ulcer is primarily due to an obliterating endarteritis and is often precipitated by infection, sunburn, or minor trauma.

The ulcers seen followed various forms of treatment with deep, superficial, and contact x-ray therapy, radium, and radon. A common sequence was found to be the interstitial application of radium followed by contact x-ray treatment for recurrence.

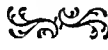
The objection that the radon ointment treatment adds further damaging irradiation to the area is proved fallacious by the results. The concentration used is no more than one-twentieth of an erythema dose. All scar tissue necroses respond in a manner similar to post-irradiation ulcers. The ionization produced is predominantly from the alpha rays. The mode of action is not entirely understood. It is believed that the alpha-ray therapy in small dosage promotes the growth of vascular tissues.

In preparation of the ointment, radon seeds 1 cm. long, of 0.5 mm. gold capillary, are broken open in a jar of hot vaseline (melting at 44° C.). Mixing is accomplished by melting and shaking after the jar has stood for twenty-four hours, and the contents are then tested for uniformity by fluorescence in the dark. Activity is checked by measurement of gamma rays emitted by the full jar before use.

Freshly prepared ointment is applied with a spatula to the lesion and a margin of about 1 cm. of healthy skin. A thickness of 2 to 3 mm. is most desirable. The ointment is covered by a rubber dam or cellophane. Applications are usually for eight hours and are repeated every week for a total of three or four applications.

Of 69 post-irradiational ulcers treated, 20 proved to be recurrences of the malignant lesion. Forty-one healed completely and 8 showed great improvement. Two typical cases are reported.

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The Roentgenographic Signs of Herniation of the Cervical Intervertebral Disk¹

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ATTENTION HAS previously been directed by two of the writers to the frequency of herniation of the cervical intervertebral disk as a cause of pain in the shoulder, arm, and chest (1). Additional reports by various authors have since appeared in the literature and the condition is well established as a clinical entity (2-6). The lesion is much the same as in the lumbar region. With the involvement of the cervical spine, however, roentgenographic findings are more definite and are present in a higher percentage of cases. Since the radiologist studies patients from many clinical sources, his is an excellent opportunity to recognize the condition and direct attention to its presence. It is the purpose of this paper to describe herniation of the cervical disk as observed roentgenographically in 32 cases verified by operation and 106 additional cases not verified but presenting the same clinical and x-ray findings.

The two divisions of the spine which undergo the greatest stress are the lower lumbar and lower cervical segments. One might expect, therefore, to find degenerative disk changes in these regions more commonly than elsewhere, and this is clinically true. The only significant difference is that in the cervical region the

spinal canal and intervertebral foramina are smaller than in the lumbar spine; hence a small herniation is more likely to be symptomatic. In addition, the nerve roots in the cervical region emerge from the dura at right angles and are compressed as they pass through the intervertebral foramina, while in the lumbar region the angle of emergence is acute and the roots are compressed against the vertebra above their exit from the canal. Stookey (7) has pointed out that it is possible for protrusion of the cervical disk to produce symptoms in three ways: first, by massive herniation and compression of the cord, with the production of symptoms similar to those of cord tumors or dislocation of vertebral bodies; second, by a small central or unilateral protrusion involving only the ventral columns; third, by a lateral protrusion impinging upon the nerve root. It is with this last type only that we are here concerned.

Nachlas (8) and later Hanflig (9) described an angina-like syndrome with pain radiating to the anterior chest wall, the shoulder, and the arm. Both believed that the underlying lesion was arthritis with nerve root compression. Turner and Oppenheimer (10, 11) made a study of 50 patients presenting the same symptoms but

¹ Presented at the Joint Meeting of the American Roentgen Ray Society and the Radiological Society of North America, Chicago, Ill., Sept. 24-29, 1944.

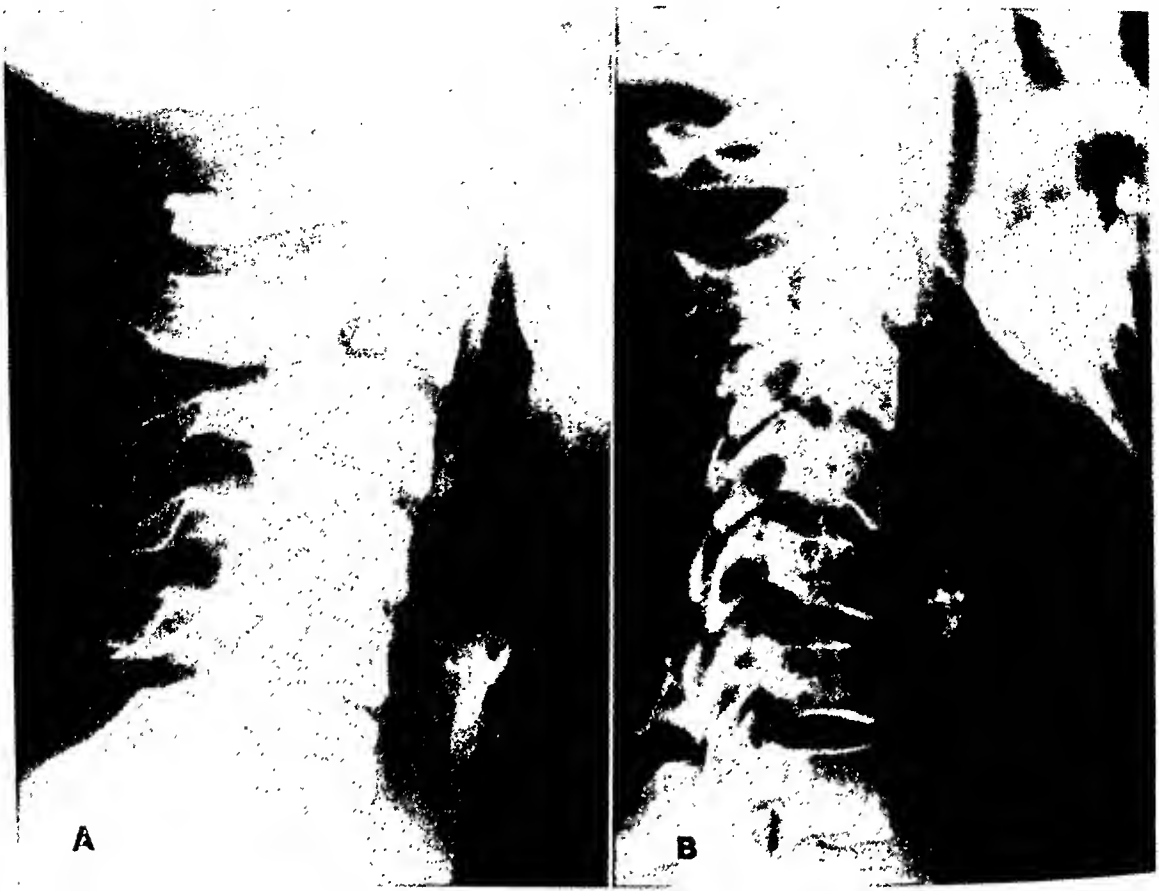


Fig. 1. A. Lateral cervical spine. Loss of normal lordosis. Lateral protrusion at fifth interspace. B. Lateral cervical spine. Loss of normal lordosis with reversal of curvature. Lesion at fifth interspace.

felt that the proliferative bone lesions were too localized to be of arthritic origin. They blamed degeneration of the intervertebral disk followed by narrowing of the intervertebral foramen and pressure upon the nerve root. None of their patients was explored, but they mentioned the possibility of displacement of loosened disk cartilage.

Lateral herniation of the cervical disk usually follows a relatively slight trauma, although some patients are unaware of any specific injury. *Not all displacement of disk tissue results in clinical symptoms.* Lesions which do produce nerve root compression are of two types:

- (1) Extruded nodules of nucleus pulposus, which are soft and radiolucent but are easily recognized when the posterior ligament is incised. These later undergo ossification and, becoming visible, are often interpreted as arthritic spurs.
- (2) Protrusions of the disk with neither

rupture of the annulus fibrosus nor extrusion of the nucleus pulposus. Ossification occurs in the late stages of this type also.

The first symptom is usually stiffness of the neck, with pain radiating to the occiput. This may disappear or recur at intervals if the degree of injury is slight. After a period of days, months, or years, pain may be felt in the shoulder, over the anterior chest wall, the medial border of the scapula and down the arm, frequently accompanied by sensory changes in one or more fingers. The chest pain may be so severe that the patient believes he has suffered a heart attack. It may be so mild as to simulate myalgia, neuritis, bursitis, or arthritis of the shoulder. Movement of the neck, coughing, sneezing, and straining may aggravate the symptoms. Supporting the arm or sleeping with it behind the head may relieve them. The patient may complain of numbness and tingling

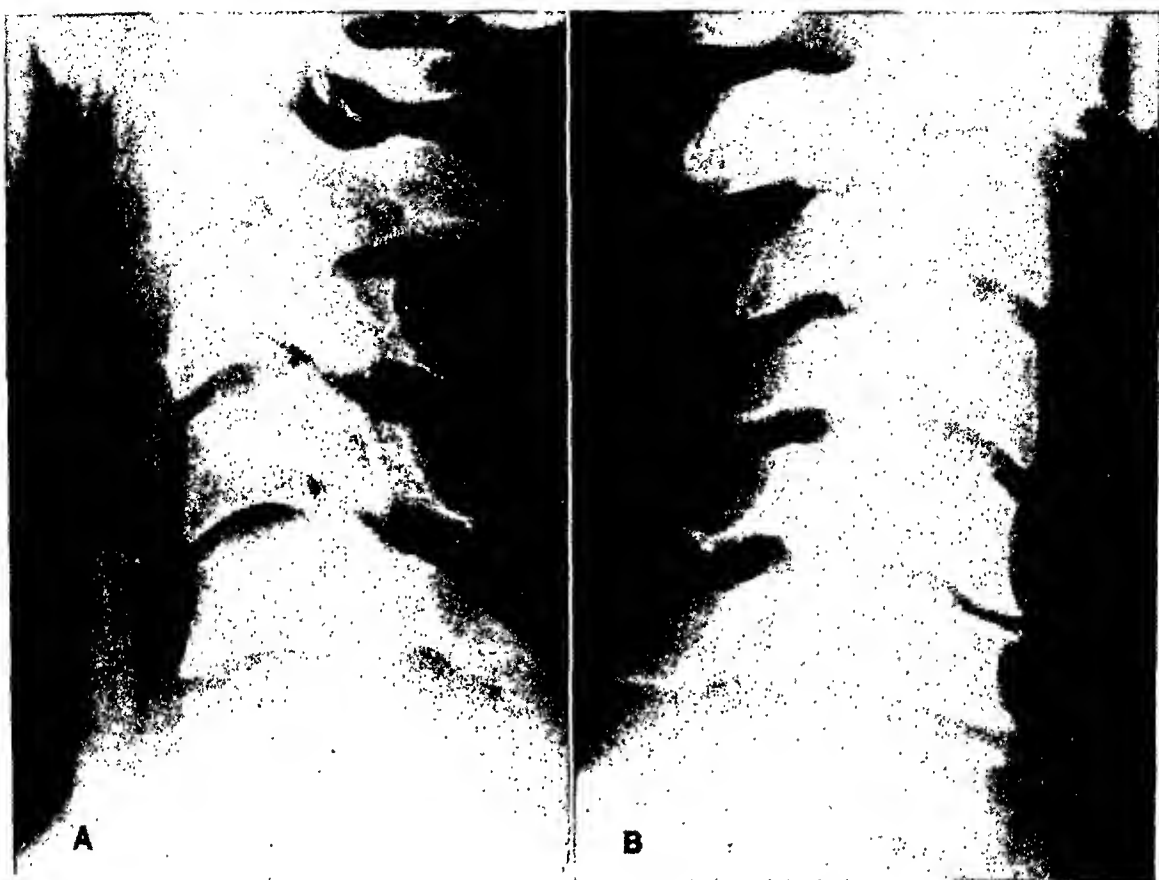


Fig. 2. A. Lateral cervical spine in 1933. Slight reversal of curvature and narrowing of fifth interspace. B. Same patient in 1942. Reversal of curvature around fifth and sixth interspaces only. Anterior spurring. Symptoms of double lesion. Operation was done, with removal of disk fragment at sixth interspace.

in the thumb or fingers or a feeling as of an electric shock running down the arm. Weakness of the grip, vasomotor changes, and, in the late stages, muscular atrophy may be observed.

The head may be carried tilted to one side with the neck extended; muscle spasm and limitation of motion may be present. The patient has a tendency to protect himself against sudden jars and against untoward movements. Of considerable diagnostic importance is the elicitation of point tenderness over the affected nerve root by compression or percussion. A positive "neck compression test" is almost pathognomonic. The test is performed by making downward pressure upon the head, which is slightly tilted toward the side of the lesion. The result is positive when the pain is intensified or the radiation to the chest, shoulder,

and arm is reproduced. This test should be performed with utmost caution.

The lesion is localized by correlation of the clinical and radiographic findings. The distribution of pain and sensory changes and the condition of the tendon reflexes are practically specific. Compression of the sixth nerve root by lesions of the fifth disk (between C-5 and C-6) results in weakness of the deltoid and biceps muscles, with diminution or loss of the biceps tendon jerk. Numbness is felt in the thumb and index finger and on the radial aspect of the forearm. Pressure upon the seventh nerve root by lesions of the sixth disk (between C-6 and C-7) results in a decrease or loss of the triceps tendon jerk. Sensory changes involve the index and middle finger and a slightly larger area of the radial aspect of the forearm. With the less common defect of the seventh disk



Fig. 3. A. Lateral cervical spine. Localized reversal of curvature at narrowed fifth interspace with calcification of extruded disk material (osteophytes) and proliferation of bone in posterior ligament. B. Lateral cervical spine. Narrowed sixth interspace. Anterior spurs. Calcified disk material and bone proliferation posterior.

(between C-7 and D-1) pressing upon the eighth nerve root, the triceps and biceps reflexes are not affected and the sensory changes are referable to the little and ring fingers and the ulnar side of the forearm. Pain in the shoulder, the mid-scapular region, and the anterior chest wall may occur with any of the lesions.

The following abnormalities are observed on the radiographs:

- (1) Loss or reversal of normal cervical lordosis, either complete or segmental.
- (2) Narrowing of the intervertebral space.
- (3) Calcified particles of disk (osteophytes) and proliferative spurs projecting into the foramen and from the anterior margins of the bodies.
- (4) Alterations in size and shape of the foramen.
- (5) Decreased mobility.
- (6) Defects in the myelogram.

None of the above findings is considered pathognomonic, as some may be present without sufficient nerve injury to produce symptoms. When, however, they are correlated with the history, symptoms, and neurological findings, they are highly confirmatory.

It is important to note that a recent or acute protrusion may be present without resulting in any x-ray abnormality. In most instances, however, there will be a loss of cervical lordosis or even a reversal of curvature. This is due, presumably, to muscle spasm, an involuntary attempt to decrease nerve compression by opening the posterior intervertebral spaces (Fig. 1). Narrowing of the intervertebral space follows loss of tension and substance of the disk. It may be observed within a few months after the onset but, as a rule, requires many months or years. In the early stages the space is usually wedge-

haped, resulting in a peculiar segmental reversal of curvature that involves only two vertebral bodies (Fig. 2). As degeneration continues, the intervertebral space becomes uniformly narrowed and irregular. This process is usually accompanied by proliferation of bony spurs around the anterior margins of the interspace, often of the "parrot-beak" variety. If the lesions are multiple, more than one interspace will, of course, be involved. These changes are essentially those of so-called "hypertrophic arthritis" (Fig. 3).

Extruded disk material tends to ossify and become attached to the posterolateral aspect of the vertebra. Additional proliferation of bone occurs in the posterior ligaments or disk capsule. In the oblique view, the resulting nodule or osteophyte can be seen projecting into the foramen, rendering it somewhat kidney-shaped. This, in addition to the decrease in vertical dimension, further increases nerve root vulnerability (Fig. 4).

Normally the foramina are bilaterally symmetrical in size and shape at each intervertebral level, their shape varying from round in the upper cervical spine to elliptical in the lower. When pathological changes of the disk result in narrowing of the intervertebral space, the vertical dimension of the foramen is decreased, usually more so on the side of the protrusion. In some instances, the articular process actually impinges against the pedicle of the vertebra above. When any of the changes described are present, films made in extreme hyperextension and flexion show little or no change in the involved segment. Most of the motion occurs in the cervical spine cephalad to the involved interspace.

Myelography is a fairly accurate diagnostic procedure when carefully done and correctly interpreted. Six cubic centimeters of contrast medium can be introduced by lumbar puncture. The descending method is preferred by some but offers no particular advantage. Difficulty is usually experienced in preventing the oil from breaking into droplets as it flows into



Fig. 4. Oblique cervical spine. Arrow points to osteophyte with resultant narrowing of foramen.

the cervical canal. This can be avoided by carefully lowering and raising the table, thus retarding the passage of the medium through the upper dorsal canal. The medium is kept from entering the cisterna magna by hyperextending the patient's head. The oil usually separates into two columns, one on either side of the cord. Defects are small and are best seen on serial films made with a fluorographic device. Displacement of the oil-filled dural sleeve surrounding the nerve root is sometimes the only positive finding (Fig. 5).

At present, there is some doubt as to whether the diagnosis of herniated cervical disk can be made more accurately by myelography than by clinical means and standard roentgenograms. We know, beyond question, that myelography fails in many instances to show lesions in the lumbar region and that a negative myelogram is no longer considered very



Fig. 5. Lateral cervical spine showing segmental reversal of curvature around sixth interspace. Myelogram exhibits rather large defect at same interspace.



Fig. 6. Lateral cervical spine, with arrow (left) indicating narrowing of seventh intervertebral space; segmental reversal of curvature. One month after operation (right) muscle spasm was relieved and normal alignment restored.

HERNIATION OF THE CERVICAL INTERVERTEBRAL DISK

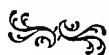
significant. In civilian practice, cervical myelography has been resorted to only when the neurological findings have been confusing or suggestive of another condition, such as a neoplastic growth. However, since no large series of cervical myelograms have been reported, one of us (F. M.) believes that this procedure should be given a thorough trial before relegating it to such a limited role.

The scope of this paper permits only a brief discussion of therapy. There is much yet to be learned about treatment of ruptured disks in any part of the spine. Excellent results have been obtained, however, in the early or soft lesions by partial hemilaminectomy and removal of the extruded particles. Complete curettage of the intervertebral space is not done. When ossification and bone proliferation have taken place, removal of the lesion is much more difficult, but decompression of the nerve root can usually be accomplished. The results are not so dramatic as with the early or soft lesion. Conservative treatment, such as traction and physiotherapy, is first given a trial and frequently affords relief. Operative treatment is reserved for those who do not respond to less radical measures. It must be held in mind that more than one disk may be involved, but this is of less common occurrence in the cervical spine than in the lumbar region.

We are indebted to Major L. M. Pascucci, M.C., for the myelogram.
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Roentgenographic Observations in Age Atrophy and Osteoporosis of the Spine¹

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WITH ADVANCING age, the bones of the human body show a well known change of structure, so-called age atrophy. This condition, described as early as 1863 by Charcot and in 1873 by Vulpian, is due to decreased functional stress, thinning of calcareous elements, and to lack of bone apposition. While simple age atrophy has no complications and does not produce any clinical symptoms, it is associated, in a certain number of cases, with decalcification of bones, producing deformities, collapse, and fractures. This condition is called osteoporosis.

The differential diagnosis between normal, uncomplicated age atrophy and beginning osteoporosis may be impossible; indeed, the two conditions may occur together. When osteoporosis predominates, it usually gives rise to symptoms, and it is at this stage that the physician is consulted. One of the most frequent sites of osteoporosis is the spine, though the disease may be observed in the long bones, maxilla, and skull. The present paper is limited to the radiologic aspects of osteoporosis of the spine.

Before Albright, Smith, and Richardson (1) published their observations on the importance of the menopause as an etiologic factor of osteoporosis, many other causes were assigned to the disease, including disorders of the thyroid and parathyroids, pituitary adenoma and Cushing's syndrome, suprarenal cortical tumor, disuse and inactivity.

The most important radiologic findings in osteoporosis of the spine are: (1) more or less generalized bone atrophy and decalcification; (2) a ground-glass appear-

ance of the vertebral bodies; (3) the fish-bone type of vertebra due to expansion of the intervertebral disk into the brittle and fragile vertebral body; (4) crushing, compression, or fracture of the vertebral bodies with secondary deformities; (5) the kyphosis of the aged.

Little has been published on the simultaneous occurrence of decalcification of the bones and marked calcifications in other parts of the body. Albright and his co-workers state that, in view of the increased excretion of calcium in the urine in the early stages of osteoporosis, it is not surprising that some of these patients have urinary calculi. According to Steindler (8), calcification of the intervertebral disk is due to disintegration, loss of elasticity, and incrustation of calcium under the influence of body weight.

We wish to stress the occurrence of calcifications in neighboring or distant organs observed in 8 of the 10 cases on which this report is based. These calcifications may be overlooked if the examination is restricted to the spine, but they are easily discovered if other organs are examined.

The pathological changes of osteoporosis of the spine can be observed first in the lateral view. Deformities of the vertebral bodies or the intervertebral disks which appear in the anteroposterior view are a sign that the disease is already far advanced.

CASE 1 (Fig. 1): Mrs. A., aged 62, shows a general decalcification of the lower thoracic and lumbar spine, increased radiolucency, marked anterior wedging of the seventh and eighth thoracic vertebrae, and an impression on the lower surface of the latter, due to expansion of the intervertebral disk.

¹ From the X-Ray Department, Drs. Gamble Brothers and Archer Clinic. Presented before the Joint Meeting of the American Roentgen Ray Society and the Radiological Society of North America, Chicago, Ill., Sept. 24-29, 1944.



Fig. 1. Case 1: Anterior wedging of the seventh and eighth thoracic vertebrae; expansion of the intervertebral disk between the eighth and ninth thoracic vertebrae.

Fig. 2. Case 2: Beginning compression of the eleventh thoracic vertebra. The seventh and ninth are decreased in height.

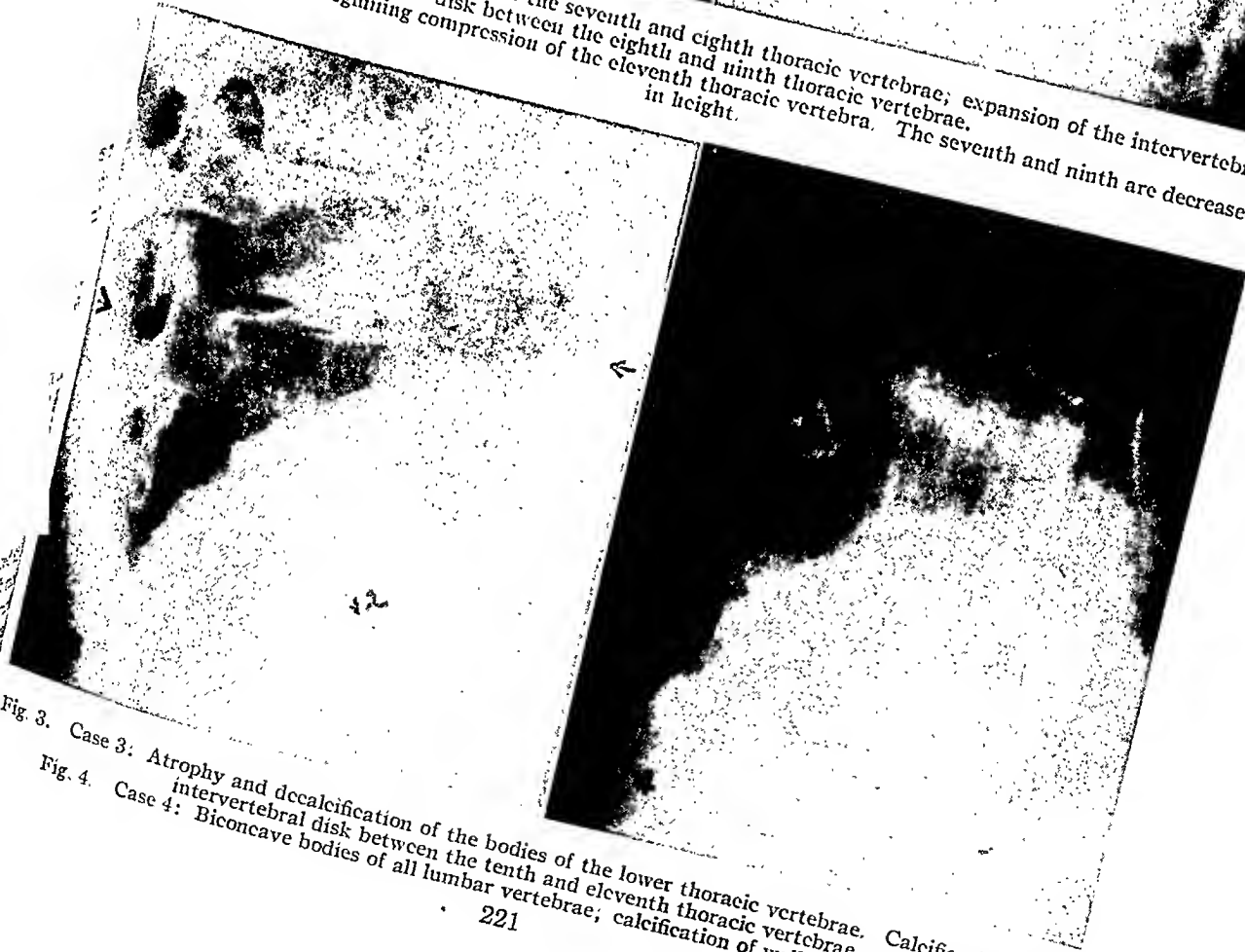
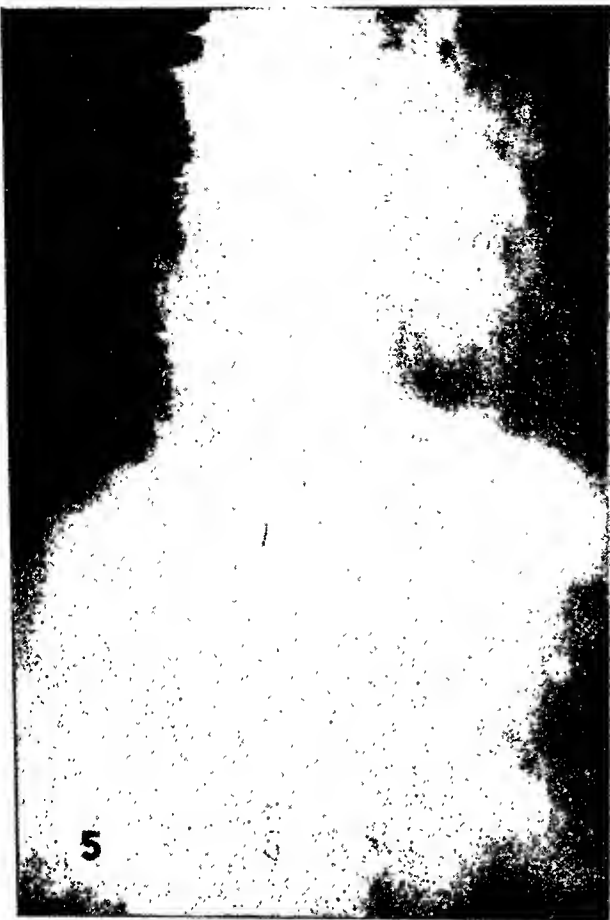


Fig. 3. Case 3: Atrophy and decalcification of the bodies of the lower thoracic vertebrae. Calcification in the intervertebral disk between the tenth and eleventh thoracic vertebrae.

Fig. 4. Case 4: Biconcave bodies of all lumbar vertebrae; calcification of wall of abdominal aorta.



Figs. 5 and 6. Case 5: Compression of the ninth, tenth, and eleventh thoracic vertebrae. Calcifications in the spleen and splenic artery are demonstrable in the anteroposterior view, in the wall of the abdominal aorta in the lateral view.

Although deformity of the seventh and eighth thoracic vertebrae is already advanced, only one vertebral body shows a concave impression, in contrast to the usual biconcave deformity of two adjacent bodies. There was no calcification of other organs in this case.

CASE 2 (Fig. 2): Mrs. B., aged 59, shows beginning compression of the eleventh thoracic vertebra giving to the upper third of the vertebral body a mottled appearance, while the intervertebral disk shows expansion on its upper and lower surfaces. The seventh and ninth thoracic vertebrae are already decreased in height. There was no calcification of other organs.

CASE 3 (Fig. 3): Mrs. N., aged 64, shows marked atrophy and decalcification of the bodies of the lower thoracic vertebrae and beginning sclerosis of the articular surfaces. While there are not yet any marked deformities, the picture is of interest because it shows a distinct calcification in the center of the intervertebral disk between the tenth and eleventh thoracic vertebrae, probably in the nucleus pulposus.

CASE 4 (Fig. 4): Mrs. P., aged 72, shows in the anteroposterior view expansion of the lower part of

the intervertebral disk into the body of the second lumbar vertebra. As was to be expected, the lateral view shows the osteoporosis to be advanced; the bodies of all the lumbar vertebrae are biconcave, but there is no wedging. In addition, there is calcification in the anterior and posterior wall of the abdominal aorta.

CASE 5 (Figs. 5 and 6): Mrs. C., a patient of 55 years, shows characteristic osteoporotic changes, with compression of the ninth, tenth, and eleventh thoracic vertebrae. The first lumbar is diminished in height. The lateral view reveals marked calcifications in the anterior and posterior wall of the abdominal aorta; in the anterior view calcifications in the spleen and the splenic artery are demonstrable.

CASE 6 (Fig. 7): Mrs. N., aged 67, has pronounced decalcification of the lower thoracic and the lumbar vertebrae. The sclerosis of the upper and lower surfaces of these vertebrae is in contrast to the ground-glass appearance of the vertebral bodies. There is no expansion of the intervertebral disk, but the first lumbar vertebra is crushed, with a chip fracture on its anterior and upper border. Only the intervertebral space between the twelfth thoracic and the first lumbar is narrowed. The

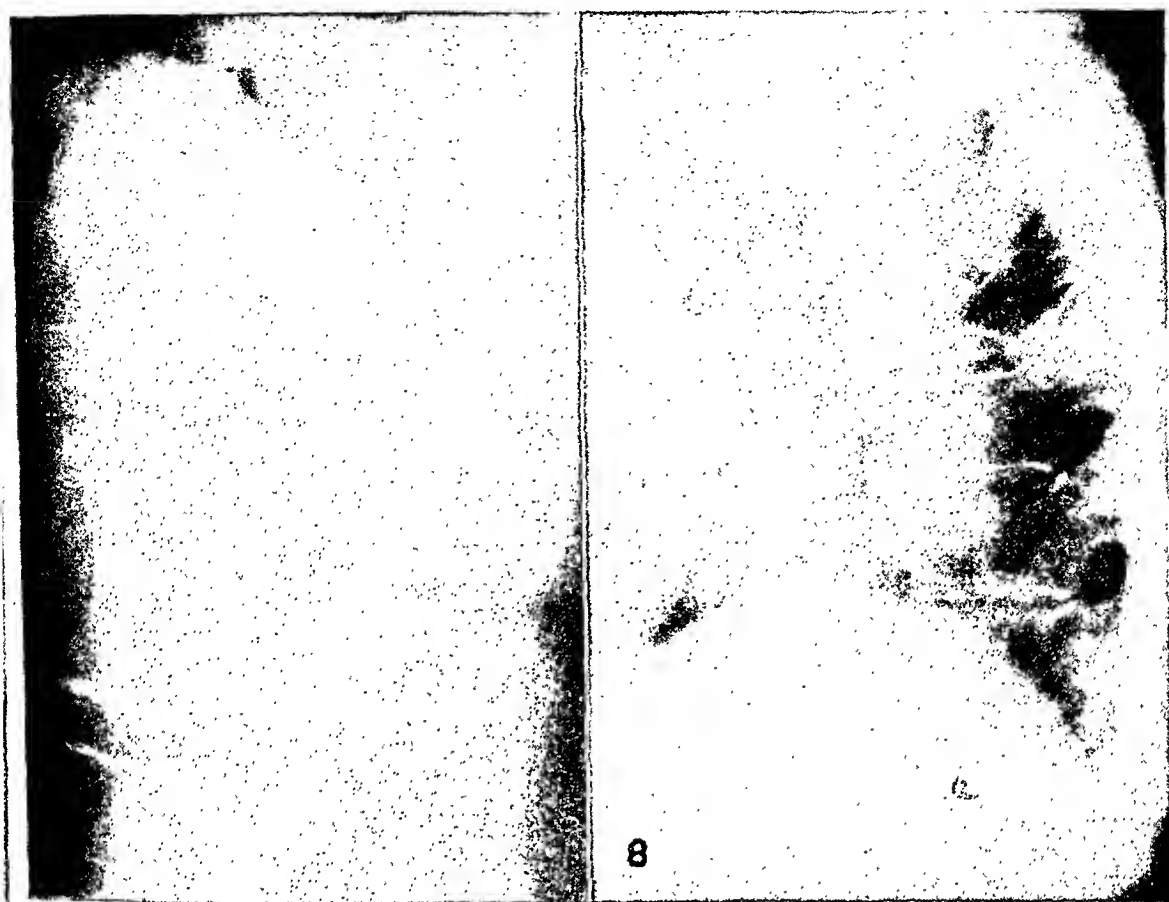


Fig. 7. Case 6: Ground-glass appearance of vertebral bodies, with sclerosis of upper and lower surfaces; fracture of anterior border of the first lumbar vertebra; calcification in the wall of the abdominal aorta.

Fig. 8. Case 8: Crushing and severe deformity of the seventh, eighth, and eleventh thoracic vertebrae. Kidney stone was observed four years earlier.

wall of the abdominal aorta is more or less calcified in its whole length.

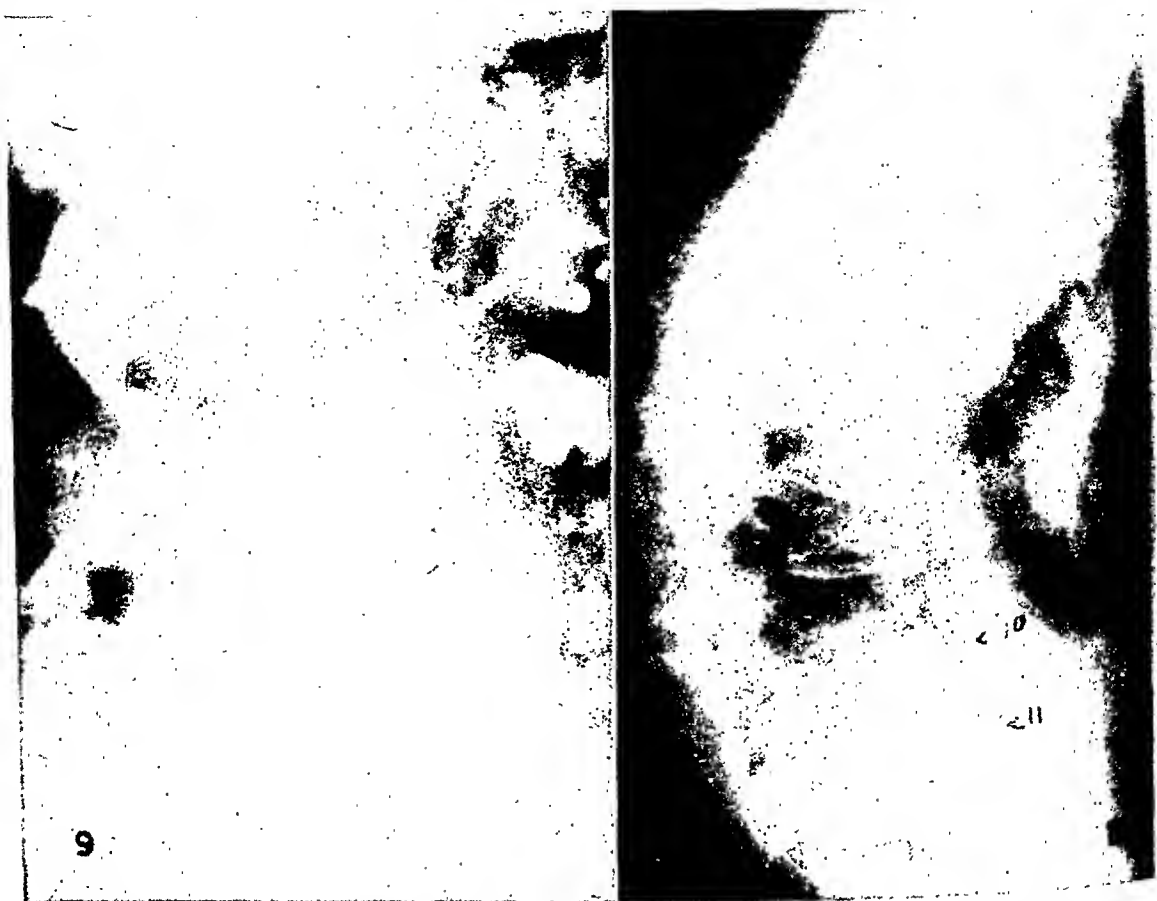
CASE 7: Mrs. N., aged 62, shows findings almost identical with those in Case 6 so far as the shape and structure of the lumbar vertebrae and calcification of the abdominal aorta are concerned. Here the twelfth thoracic vertebra is crushed, and the impression on its upper surface is more concave.

CASE 8 (Fig. 8): Mrs. T., aged 68, was first examined in 1940, showing at that time a roundish concretion in the area of the left kidney. Four years later, in 1944, she had severe osteoporosis of the thoracic and lumbar spine with kyphosis, decalcification, biconcave vertebral bodies, crushing and deformities of the seventh, eighth, and eleventh thoracic vertebrae.

CASE 9 (Figs. 9 and 10): Mrs. C., aged 66, was first examined in 1938. At that time multiple calcifications and concretions, large and small, were observed, some of them in the area of the left kidney, some of them in the splenic area. Another picture, taken three years later and including the lower thoracic spine, shows, in addition to these concretions, calcifications in the intervertebral disks

between the seventh and eighth and the ninth and tenth thoracic vertebrae. The lateral view shows osteoporosis, compression of the tenth, eleventh, and twelfth thoracic vertebrae, and biconcave intervertebral disks between the first and second and third and fourth lumbar vertebrae. In 1942, this patient had a partial parathyroidectomy, although there had not been any definite signs of parathyroid disease. The control examination in 1944 showed no further progress of the disease, possibly as a result of the operation.

CASE 10 (Figs. 11 and 12): Mrs. G., aged 65, in December 1943 showed, in an anteroposterior view, two large calcifications in the pelvic area, representing calcified fibromata of the uterus, which the patient was known to have had for many years. There was a slight decrease in the height of the fourth lumbar vertebra, with increased density on its upper border. A lateral view, taken when the patient had complained of severe backache after carrying a lunch tray, shows a ground-glass appearance of the vertebrae, beginning compression of the eleventh thoracic vertebra, and a biconcave disk between the first and second lumbar. A few months



Figs. 9 and 10. Case 9: In the anteroposterior view, multiple calcifications in the area of the spleen and left kidney. In the lateral view, compression of the tenth, eleventh, and twelfth thoracic vertebrae; biconcave impressions on lumbar vertebrae.

later, in March 1944, the first, second, and fourth lumbar vertebrae, as well as the eleventh thoracic, were shown to be crushed. A thyroid adenoma existing for many years was removed in May 1944 and since then, equipped with a brace and corset, the patient has improved. The first, second, and fourth lumbar vertebrae show a certain increase in height, without any visible new bone formation. This case indicates that a certain degree of recovery is possible under proper treatment and care.

Nathanson and Lewitan (7) followed 6 cases of osteoporosis for a number of years. They reported that their cases were incidental to senile and debilitated conditions and that very little pain, or none at all, was referred to the spine. All of our patients have been more or less in the state of senility, but localized pain at the site of the deformities was a symptom in the majority of the cases.

All of the cases reported in this paper occurred in women from 59 to 85 years of age. A few weeks ago, however, we ob-

served a case of osteoporosis of the spine in a man of 70 years. The rarity of the condition in men is stressed by Albright, de Lorimier (5), and others. The sex ratio is about 3 or 4 females to 1 male.

Atrophy and decalcification of the vertebral bodies have been the predominant finding on which the diagnosis was based in all of our cases. Next in frequency (8) per cent) were wedging, compression and fracture of one or several vertebrae, and the presence of calcifications elsewhere. The fish-bone type of vertebra was observed in 70 per cent, ground-glass appearance in 60 per cent, and kyphosis of the aged in 30 per cent of our cases.

The wall of the abdominal aorta was found to be the site of calcifications in 40 per cent of our cases, the intervertebral disk in 30 per cent, kidneys and spleen in 20 per cent, and the uterus and other arteries in 10 per cent. In 20 per cent of the series



Figs. 11 and 12. Case 10: In the anteroposterior view, calcified fibromata of the uterus. In the lateral view, ground-glass appearance of vertebral bodies of eleventh thoracic and first, second, and fourth lumbar vertebrae.

no calcifications in other organs were observed. The failure to observe calcification in these cases, however, is no definite proof that they did not occur, since the patients were seen some years ago, before we had become interested in these manifestations, and the examination was not extended to other regions of the body.

All patients with senile osteoporosis of the spine should be examined for the presence of calcifications in other organs and, conversely, the occurrence of calcifications in elderly patients with or without specific complaints ought to suggest the possibility of senile osteoporosis and serve as an indication for x-ray examination of the spine, skull, and pelvis if the symptoms do not involve other bones.

The diagnosis "age atrophy" should be used to designate the physiological uncomplicated changes, the diagnosis "osteoporo-

porosis" being reserved for the pathologic condition. Actually the terms are frequently used indiscriminately for either condition.

With the increase of the average life expectancy of the population, the importance of geriatric medicine has been recognized more and more. Early diagnosis secures early treatment, making life more comfortable and prolonging the patient's ability to work.

SUMMARY

The roentgenographic findings in 10 cases of osteoporosis of the spine are described.

The simultaneous occurrence of calcifications in other organs is discussed.

The relative incidence of the different symptoms of the disease and of the site of the calcifications is mentioned as a possible aid to the diagnosis.

The use of the term "age atrophy" for the physiological uncomplicated changes and of the term "osteoporosis" for the pathologic condition is suggested.

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Reflex Hyperemic Deossifications

Regional to Joints of the Extremities¹

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LOCALIZED deossifications in the extremities are rather common findings. Yet it appears that varied interpretations are offered as to their significance. Not infrequently they are ignored. Perhaps there may be a statement to the effect that there is an "osteoporosis," insinuating a passive type of bone absorption, such as might be related to disuse. In cases of conspicuous absorptions, however, there is the opposite tendency—i.e., to exaggerate the roentgen evidence, even to the extent of assuming the presence of an infection or possibly a neoplasm.

At least 7 referred cases are known to the writers wherein this latter extreme of interpretation prevailed. In 2 of these, amputations had been performed, but histopathologic studies revealed no evidence of malignant growth or even of infection—no substantial basis, indeed, for the amputations. In several of the other cases, amputations had not been performed but the cases had been referred for that purpose. Incisions for drainage of supposed abscesses or actual infections of joints were made in 5 of the patients. Yet in all of these instances, the roentgen evidence really indicated an active deossification process—a reflex hyperemic deossification—and clinical sequelae provided support for this latter diagnosis.

This condition was a problem of considerable importance during World War I (3, 4, 8) and no doubt it is of considerable importance in war surgery today. It is, of course, a matter of no minor concern in civilian orthopedics, as well (6, 9, 10-14, 21, 23, 24).

It has long been known that intra-

osseous hyperemia is the essential physiological basis for *localized* deossifications. In 1900, Sudeck (25) described "acute" bone atrophy as related to infections, with emphasis upon the factor of inflammation. Shortly thereafter, Kienböck (18) described similar findings following trauma, and cited the likelihood of a trophic factor. In 1901 Sudeck (26, 27) combined these ideas, correlating acute deossifications with trauma as well as with infection. He described associated clinical features, such as pain, muscle atrophy, cyanosis, and edema, all of which he believed to be *secondary* to the deossification. The process he designated as a "reflex trophoneurosis" on a vasomotor basis. Clearly distinguishing the changes from those of other nerve defects, as in anterior poliomyelitis, tabes, and syringomyelia, he thereby established an entity to which his name has been applied as an eponym—"Sudeck's atrophy."

Leriche and Policard (19) in their work on the physiology of bone have commented: "If, by any process whatever, the activity of the circulation is increased in the vicinity of bone, the latter becomes rarefied." Likewise, Grieg (7) has written: "Every trauma of bone is followed by a reactionary local-hyperaemia, and every disease resulting in bone rarefaction or decalcification is accompanied by a more or less copious and prolonged increase of the arterial and capillary circulations." R. Watson Jones (16, 17) has expressed similar ideas, describing "spontaneous hyperaemic dislocation of the atlas" as a result of inflammations in the pharynx.

Miller and de Takats (22) accomplished

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Fig. 1. Reproductions from the monograph of Lexer, Kuliga, and Turk, showing the distribution of the vascular beds in the tibia, fibula, a metatarsal and the tarsals (calcaneus and talus). Note the dense arborizations and anastomoses in the metaphyseal regions of the tibia and in the distal metaphysis of the fibula. Otherwise, note the conspicuous distribution of vascularity through the *extremities* of the metatarsal and the tarsals.

plethysmographic studies of the blood flow on 12 patients manifesting painful osteoporosis following injury. They concluded that "there was increased blood flow in the affected limb, varying from 60 per cent to as little as 5 per cent"; these increases in blood flow being greatly out of proportion to the increase in volume of the part. Other writers, Campbell (2) and Ferguson (5), also have laid much emphasis on the relationship of hyperemia to deossification.

OBSERVATIONS

Most of the cases with which the present study is concerned were obtained from the files of the Willis C. Campbell Clinic in Memphis, Tenn. They were selected at random from cases listed as osteoporosis, infectious arthritis, fractures (in particular, involving the tarsals or carpals), amputations, transverse myelitis, poliomyelitis, peripheral nerve injuries, tabes dorsalis, and various neoplasms—varied conditions in which one or another type of deossification was to be expected. In all, more than 350 cases were studied. In 239

of these, deossifications were sufficiently evident about the joints to warrant comment, and these cases were studied in detail. Joints of the feet and ankles were involved in 124 instances; those of the hands and wrists in 70 instances; the knees in 21; shoulders in 18; elbows in 6.

The procedure was first to study the film and, on that basis alone, to classify the deossification pattern. In each instance record was made as to the probable etiology. Subsequently, the clinical and laboratory records were obtained and the preliminary analysis, together with the pertinent films, was reconsidered.

Active reflex hyperemic deossification was identified, in contradistinction to passive diminution in the inorganic osseous elements, on the basis of discrete dissolutions—localized absorptions rendered conspicuous because of the substantiality of the bone between the sites of absorption. The areas of dissolution were found to coincide with the patterns of vascularization as described in the detailed studies of Lexer, Kuliga, and Turk (20) and mentioned by Johnson (15).

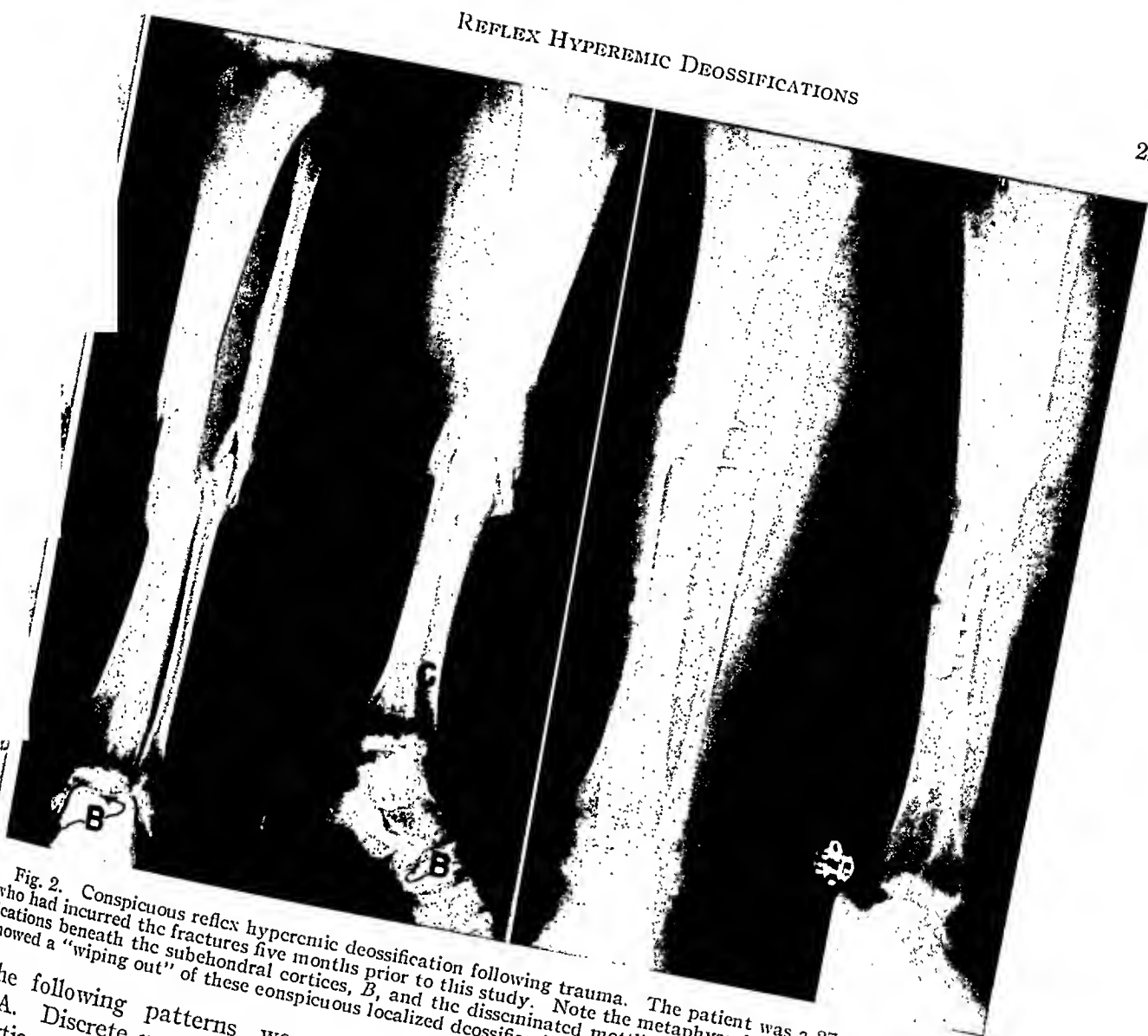


Fig. 2. Conspicuous reflex hyperemic deossification following trauma. The patient was a 27-year-old female who had incurred the fractures five months prior to this study. Note the metaphyseal bandings, *A*; the deossifications beneath the subchondral cortices, *B*, and the disseminated mottlings, *C*. Later studies, on the right, showed a "wiping out" of these conspicuous localized deossifications and a more diffuse mottling.

The following patterns were observed:

A. Discrete mottlings through a large portion of the bone or throughout several bones of a part. This type of deossification was especially prominent in the tarsals and in the carpals, but it was also found through the more cancellous portions of long bones—their extremities. It was thought to be related to hyperemia of terminal branches of the nutrient artery and their anastomoses with cortical perforating vessels (as contained in Volkmann's canals).

B. Deossifications in metaphyseal zones or throughout the ends of the bones. Though it is likely that this pattern represents a more localized exaggeration of the change described as discrete mottling,

it was considered as a distinct type when the dissolutions in these regions were contrastingly conspicuous—so conspicuous as to produce the appearance of a rarefaction band. Distinct "banding" was found particularly in the metaphyseal zones of the tibia and, to a lesser extent, in the radius, whereas in the ulna, fibula, and the metatarsals and metacarpals, these progressive changes were more generalized throughout the epiphyseal extremities. May not these differences be related to differences in the vascular beds of these various bones and portions of bones? It would seem reasonable to explain the changes upon such a basis—a particular hyperemia of the perforating metaphyseal vessels and their anastomoses with epiphyseal branches or,

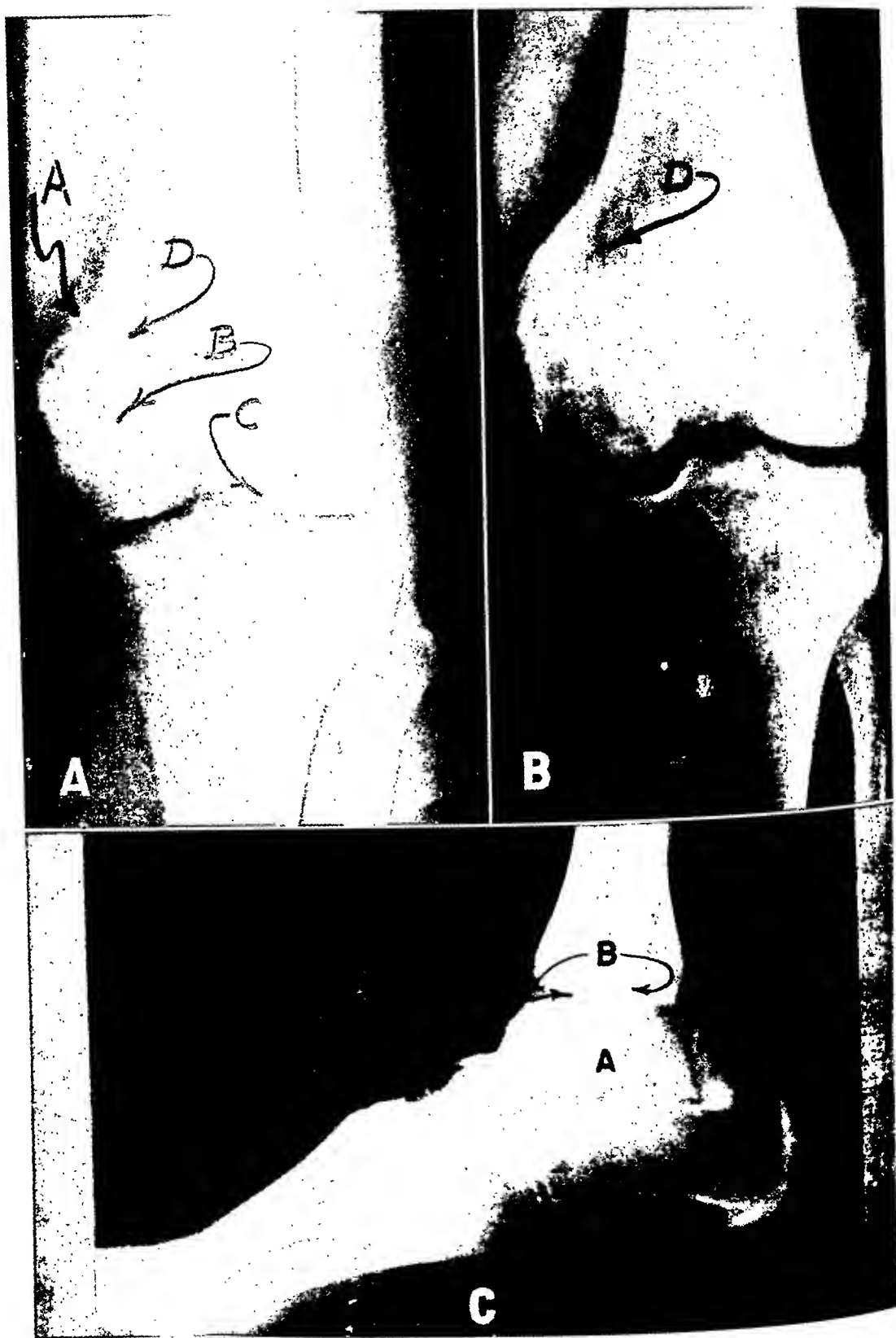


Fig. 3. Deossifications following treatment regimes.

A. and B. Molecular fracture and immediate hot packs. Because of persistent pain and swelling and the roentgen evidence of periosteal reaction (A) and disseminated mottlings (B), neoplasm was suspected. However, the deossification beneath the subchondral cortices (C) prompted the consideration of reflex

[Legend cont. on opposite page]

otherwise (*i.e.*, bases of metatarsals, metacarpals, etc.), with the cortical perforating vessels of the ends of the bone.

C. Deossifications beneath the subchondral articular cortices. This pattern was commonly found in the peripheries of the tarsals or the carpals, regardless of the irritating factor concerned. In cases of infectious arthritis, it appeared to be primarily concerned with the cortices adjacent to the joint involved. Explanation for this type of dissolution would seem to be the existence of a particular hyperemia of the terminal arcuate vessels which ordinarily nourish the articular cortices and the joints themselves.

D. Progressive stages of reflex hyperemic deossification appeared to be manifested by a combination of two or all three of these patterns and, finally, by diffuse mottling of rarefaction, which in many instances involved all portions of a bone or several bones. The explanation for these more extensive changes appears to be a widespread hyperemia, or the element of time may account for a gradual expanse in the absorptions.

Among the 239 cases selected on the basis of conspicuous deossifications, the incidence of the patterns described above was as follows:

- A. Discrete mottlings.....121 cases (50.6%)
- B. Distinct bandings..... 61 cases (25.5%)
- C. Deossifications beneath subchondral cortices..... 72 cases (30.1%)
- D. Diffuse mottling..... 84 cases (35.1%)

It is obvious from these figures that more than one pattern was found in many of the cases. The combinations noted were as follows: discrete mottling plus distinct banding, 20 cases (8.4 per cent); discrete mottling plus deossifications beneath the subchondral cortices, 19 cases (7.9 per cent); distinct banding plus deossifications beneath the subchondral cortices, 12 cases (5.0

per cent); discrete mottling plus distinct banding plus deossifications beneath the subchondral cortices, 16 cases (6.9 per cent); discrete mottling in one bone plus diffuse mottling in a nearby bone, 3 cases (1.3 per cent); distinct banding in one bone together with diffuse mottling in a nearby bone, 4 cases (1.7 per cent); distinct banding plus deossification of the subchondral cortices in one bone together with a diffuse mottling in the nearby bone, 4 cases (1.7 per cent); deossifications of the subchondral cortices with regional diffuse mottling, 3 cases (1.3 per cent); all three patterns in one bone together with regions of diffuse mottling, 2 cases (0.8 per cent).

The etiological factors related to these changes were found to be as follows:

1. Trauma
 - (a) Ordinary contusions
 - (b) Tendon and/or ligamentous sprains
 - (c) Over-energetic physical therapy
 - (d) Surgical procedures such as arthrodeses or amputations
 - (e) Fractures (regional to the sites of the deossification or even separated from such sites by one or several joints)
2. Infections
 - (a) Chronic cellulitis
 - (b) Localized osteomyelitis
 - (c) Infectious arthritis
3. Neoplasms
 - (a) Regional vascular
 - (b) Malignant infiltrative

Every one of these factors accounted for active reflex hyperemic deossifications. The more passive types of deossification, featured by disseminated stipplings such as are found in connection with ordinary disuse or after limited use of a part due to nerve loss (*i.e.*, poliomyelitis), were not included. Neither were there included generalized deossifications—such as those related to deficiencies of bone formation, nutritional deficiencies, or endocrine changes—except where the above-men-

hyperemic deossification and with hot spot illumination the molecular fracture (D) was discerned. The hot packs were removed and the pain was relieved. Studies made two months later (Fig. B) showed more definite evidence of callus and the molecular fracture (D). Courtesy Capt. D. G. Butera, A.A.F. Overseas Replacement Depot, Greensboro, N. C.

C. Triple arthrodesis and posterior bone block. Studies were made nine weeks following surgery, which had been performed because of a "jake paralysis" (due to the drinking of Jamaica ginger) of eleven years' duration. There was no evidence of infection following operation. Note the regional mottling of deossification (A) and the deossification beneath the subchondral cortices (B).



Fig. 4. Reflex hyperemic deossification related to infectious arthritis. This was a very acute process, a gonococcal arthritis. Note the deossifications beneath the subchondral cortices (A). When found regional to a single joint, this evidence should provoke the consideration of an infectious arthritis, though the same evidence may occur about many joints, following trauma. To distinguish between these two factors, corroborative evidence should be sought, such as erosions (C) or expansion of the capsule (B). The history is, of course, very important.

tioned factors were found to be superimposed.

Trauma was the predominant etiological factor. It appeared to be the primary factor in 175 instances (74 per cent). It was rather surprising to find so many cases—58 altogether—based upon ordinary contusions (17 cases) or sprains (41 cases). Even though there was no evidence of fracture, these patients showed discrete mottlings, distinct bandings, and even deossifications beneath the subchondral cortices (especially in the tarsals). It was difficult to determine the number of cases in which these changes might be attributed to the early use of hot packs, diathermy, or other over-zealous physical therapy, but a number appeared to be so related. Likewise, it was difficult to identify the direct relationship between surgical procedures, such as amputations or arthrodeses, for in most of these cases the indications for

surgery were at the same time factors which might be related to reflex hyperemic deossifications.⁶ However, the relationship between over-zealous physical therapy shortly after injury or even surgical trauma can hardly be disputed, particularly after studying cases such as represented in Figure 3.

One or more fractures were found in 110 of the 239 cases. In fact, the incidence of fracture as a causative factor of hyperemic deossification appears to be so great that it would seem that in the questionable case this factor should be considered first and every effort should be made to locate the fracture site. The fracture may be "molecular" in type and difficult to discern (Fig. 3). Thus a not clearly explainable

⁶ Our interest was first directed to hyperemic deossification following amputations, at the suggestion of Capt. George M. Wyatt, M.C., Walter Reed General Hospital, Washington, D. C.

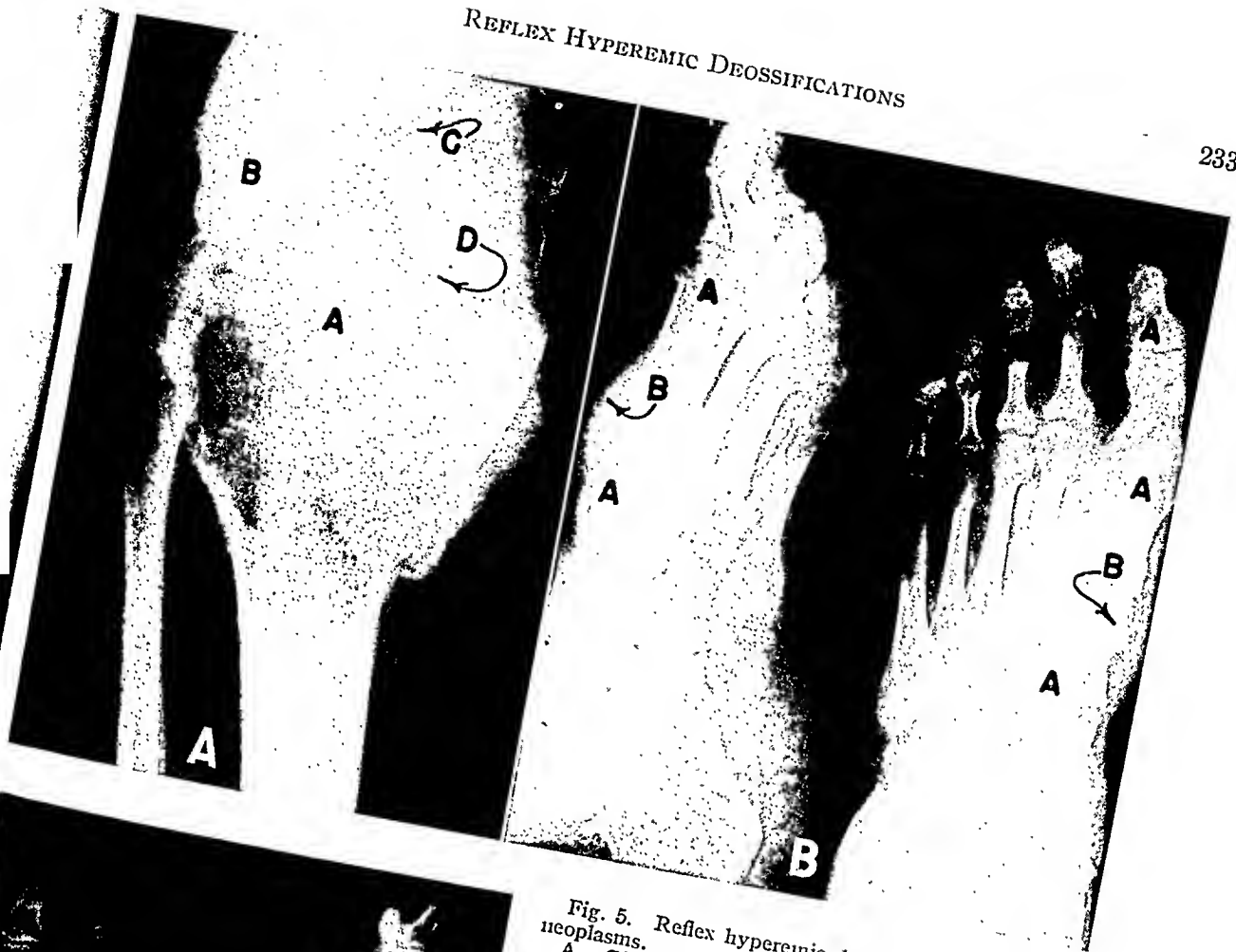


Fig. 5. Reflex hyperemic deossifications related to neoplasms.

A. Giant-cell tumor. This patient, a farmer aged 19, had struck his right knee while at work. Note the "explosive" type of defect (A); in addition, in a bone distinctly separated from the lesion, the discrete mottling (B), metaphyseal banding (C), and deossification beneath the subchondral cortex (D).

B. Osteogenic sarcoma. A 38-year-old male had sustained a contusion as a result of a 40-lb. weight falling across his foot, about five months prior to this study. There was no evidence of fracture but considerable "post-traumatic painful osteoporosis." Note the diffuse mottling (A). The foot was amputated ten weeks after the application of a cast and a "chondrosarcoma" (B) was identified in the base of the first metatarsal.

C. Endothelial myeloma. Note the mottled destruction of the neoplasm (A) and the deossification beneath the subchondral cortex of the adjacent bones (B). Biopsy revealed endothelial myeloma.

fracture may be located at a considerable distance from the deossification reaction. Whereas the bones of the feet and hands are especially susceptible to dissolution, the fracture may be located in the bones of the leg or thigh or in the forearm or arm, respectively. Any or all patterns of deossification may be found. The greater the degree of violence and/or the longer the period intervening between the injury and the roentgen examination (up to eight

deossification may provide the clue to the existence of an insufficiency fracture. The

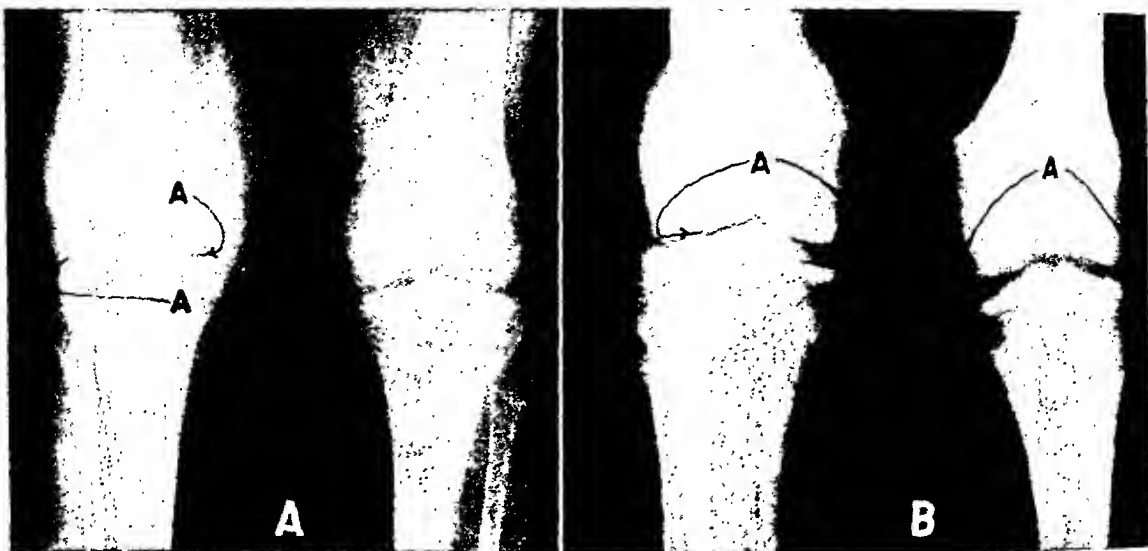


Fig. 6. Deossifications in depleted bones.

A. Osteopsathyrosis. A 20-year-old male had incurred fractures every year since birth. Several weeks prior to this study, he had received a blow to his right knee. Note the deossification beneath the subchondral cortices (A) on the right side, in contrast to the pattern of the left.

B. Hyperparathyroidism. Studies of this patient revealed generalized sparsity and coarsening of the trabeculations, granular deossification of the skull, and many cystic defects in the skeleton, as well as disseminated calcifications in the kidneys. An adenoma of the parathyroid was removed. Note the deossifications beneath the subchondral cortices (A). Courtesy, Lt. Col. Joseph C. Bell, Percy Jones General Hospital, Battle Creek, Mich.

months or a year), the greater, ordinarily, is the amount of bone dissolution.

Our film studies indicated that prolonged immobilization, or too early use of an injured extremity, was followed by conspicuous deossification, whereas properly graduated active exercise favored reossification. This observation is in accord with the theory advanced by Blair (1), that contractions and relaxations of the muscles in an extremity are responsible for normal calcification of the associated bones. The oldest age group showed the most conspicuous deossifications. In particular, females over forty appeared to be susceptible to marked degrees of bone absorption.

Reflex hyperemic deossification was found in 46 cases of infection. Whereas it was to be expected regional to a localized infection of bone, it was rather surprising to find these changes in connection with infections which were limited to the soft tissues. In the case of infected joints, very conspicuous deossifications were observed beneath the adjoining subchondral cortices. With very acute processes of this sort, these deossifications were found

within two or three weeks (*e.g.*, gonococcic arthritis), whereas in the low-grade processes (*e.g.*, tuberculous arthritis) the deossifications were less conspicuous and more extensive. In many instances, it was difficult to identify infection as the causative factor. At times, in addition to very carefully analyzing the roentgen evidence, with search for corroborative criteria (*i.e.*, expansion of the joint capsule and/or erosions of the osseous articular cortices), it was also necessary to consider carefully the clinical aspects; in particular, to inquire as to whether or not there was a septic type of fever, leukocytosis, and even more important, whether pain had its onset following trauma or developed insidiously with no external provocation.

Reflex hyperemic deossification was observed in 14 of 61 cases of bone neoplasm. It was a particular feature in the cases of true giant-cell tumor but was lacking in giant-cell tumor variants—fibrous dysplasia, non-osteogenic fibroma, and solitary bone cysts. It was found in highly vascular lesions such as endothelial myeloma and some of the osteogenic sarcomas.

In the neoplastic cases, mottlings of

dissolution regional to the site of the definite lesion were not considered, for it was realized that such might be produced by tumor infiltration. Only localized deossifications in a bone neighboring the bone involved were considered. Here the most common type of dissolution was of the pattern of discrete mottling, though a few of the cases showed distinct banding and even deossification beneath the subchondral cortices.

Deossification beneath the subchondral articular cortices was observed in one case of hyperparathyroidism in which trauma was denied. It was also found in a case of osteopsathyrosis following a contusion.

Approximately 16 cases of Charcot joints were studied. Not one of these showed the hyperemic type of deossification. This, of course, is consistent with physiological reasoning—the afferent nerve paths being interrupted in these cases.

CONCLUSIONS

1. Deossification should be considered reflex and hyperemic in type when the roentgen picture shows *localized* areas of bone dissolution, rendered conspicuous because of the substantial structure of contiguous bone.

2. The areas of rarefaction may be disseminated through a large portion of a bone or bones, presenting the appearance of discrete mottlings. Such a picture would seem to indicate hyperemia of terminal branches of the nutrient arteries together with their anastomotic connections with cortical perforating vessels.

3. The rarefaction may be conspicuously concerned with the metaphyseal regions, producing the appearance of metaphyseal bands (especially in the case of the distal tibia) or they may be conspicuously concerned with the ends of bones. Such evidence would seem to signify hyperemia involving the cortical perforating metaphyseal vessels and their anastomotic connections with the epiphyseal vessels (and to a lesser extent with the communicating channels from the nutrient artery).

4. The rarefactions may predominantly be concerned with the zones beneath the subchondral articular cortices. Such evidence would seem to signify hyperemia involving the terminal arcuate vessels.

5. In the earlier stages of reflex hyperemic deossification, even as early as three weeks following the onset of irritation, any one of these three vascular distributions may be characterized by conspicuous rarefaction. In reaction to intense irritation or after several months of lesser degrees of irritation, the rarefactions may involve a combination of two or all three of these vascular beds. Ultimately, the roentgen appearance may be that of a blending of the patterns—a diffuse mottling of dissolution.

6. Discrete mottlings of deossification, distinct bandings, deossifications beneath the subchondral cortices, or diffuse mottlings—any one of these or a combination of them should be recognized as a *sign* which should serve as a challenge to the roentgenologist as well as the clinician, a challenge to identify the cause.

7. Reflex hyperemic deossification may be produced by a variety of etiological factors: (a) trauma, including relatively minor degrees (simple contusions, sprains, over-energetic physical therapy⁶) and such major degrees as actual fractures or surgical procedures; (b) infections, including chronic cellulitis, localized osteomyelitis, and infectious arthritis; (c) neoplasms, including, in particular, giant-cell tumors and other highly vascular lesions.

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DISCUSSION

(Papers by Whiteleather, Semmes, and Murphy; Marum; de Lorimier, Minear, and Boyd.)

John W. Pierson, M.D. (Baltimore, Md.): Ever since the subject of herniation of the intervertebral disk was first broached, our attention has been focused on the lumbar region because that is the area in which herniation usually occurs. We have now learned that herniated disks may be found in the cervical region as well, and Dr. Whiteleather and his associates have properly called this matter to our attention. They have described excellent methods for detection of the condition by roentgenographic examination. There are two points in their presentation which should be stressed. One is their meticulous technic; the other is the importance of correlating the roentgen findings with the clinical observations.

Dr. Marum has shown us an example of typical deformities occurring in osteoporosis. There is one remark I would like to make in this connection. Those cases in which wedging of the vertebrae ensues present some difficult differential diagnostic problems. At least, they do to me; so often does the problem arise as to whether or not we are dealing with a metastatic malignant lesion.

Dr. Marum stresses the concomitant occurrence of calcification in other portions of the body. Frankly, I do not know how much importance to attribute to that when I bear in mind the fact that he is dealing with an age group which we all know shows many calcifications.

Colonel de Lorimier and his co-workers have made a painstaking study of an interesting and somewhat mysterious group of lesions. They do well to point out the pitfalls in the diagnosis in this group of cases. I, too, have seen gross errors in diagnosis. Their observations regarding etiology are acute and accurate. They have described and classified the lesions with meticulous care. Their suggestions regarding the possible mistakes in therapy are definitely apropos. I wish to emphasize their statement that deossification may occur with relatively mild forms of trauma, an observation that is exceedingly important in both military and civil life.

Non-Disabling Bronchiectasis¹

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THE PURPOSE of this report is to point out that a diagnosis of bronchiectasis does not always indicate a chronically ill patient with severe cough and abundant expectoration of sputum, and to direct attention to a group of soldiers with bronchial dilatation with few symptoms, or none at all, who were able to perform full military duty. These men have been followed for as long as two years, even though most of them were discharged from the army.

Our interest in this disease was stimulated by the discovery of 41 cases in the course of routine chest examination of 156,000 candidates² for flying training (1, 2). All the men were first examined by the photoroentgen method, with 4 × 5-inch films. Suspicious findings were checked on 14 × 17-inch films, and if they were confirmed, the candidate was hospitalized. Several factors account for the relatively small number of cases of bronchiectasis discovered. The men were in the 18-26 year age group and all had had at least one previous physical examination. Thus, those with frank pulmonary disease had already been disqualified. Moreover, as Evans and Galinsky (3) point out, if one is to recognize bronchiectasis he must bear in mind its possibility. This is exemplified in the following table, which shows the incidence in successive groups of approximately 32,000 men each.

Number of Men	Number with Bronchiectasis
0- 32,000.....	3 (0.009%)
32,001- 64,000.....	11 (0.039%)
64,001-100,000.....	14 (0.039%)
100,001-132,000.....	9 (0.028%)
132,001-156,000.....	4 (0.017%)
TOTAL	41 (0.026%)

The first group of 32,000 men had the lowest percentage of previous chest films

and the lowest incidence of bronchiectasis. Those in the other groups had practically all had earlier x-ray studies. It is probable that some cases were missed in the first group as a result of our not attaching enough importance to or failing to recognize the slight roentgenographic signs on the miniature films, which in the succeeding groups led us to obtain bronchograms in a large number of cases.

There are few reports in the literature concerning mildly symptomatic or "dry" bronchiectasis. The cases described by Evans and Galinsky (3) were found in soldiers who were admitted to the hospital for treatment of acute respiratory infections. Our patients were ambulatory and the disease was discovered on routine examination. Martin and Berridge's series (4) most closely resembles ours. Twenty-five recruits for the British armed forces were found to have bronchiectasis, of whom 23 had cough and expectoration and 7 had hemoptysis. The authors felt that the prognosis was quite good and that there would probably be little future disability.

CLINICAL FEATURES

All the men in our series had been in active service for some time, from two months to as long as two years. None had been incapacitated to any degree, though several had had pneumonia since entering the service. None of the 41 men had been to sick call an excessive number of times. Indeed, the physical requirements for candidates for flying training are so rigorous that men in poor physical condition or with numerous medical complaints would not have had their applications approved.

No attempt has been made to link any

¹ Presented at the Joint Meeting of the American Roentgen Ray Society and the Radiological Society of North America, Chicago, Ill., Sept. 24-29, 1944.

² Of these, 132,000 were examined at Nashville Army Air Center, Nashville, Tenn., and 24,000 at Basic Training Center No. 10, Greensboro, N. C.

specific childhood disease with the development of bronchiectasis, as past histories were not too reliable, especially in regard to the severity and duration of illnesses. Moreover, those who had symptoms could not give the exact date of onset. In one instance (Case I) a seed had been aspirated; $\frac{1}{2}$ men who had had pneumonia were inclined to date their symptoms from that disease. All had a tendency to minimize their symptoms and considered their cough and expectoration as of no significance. As a matter of fact, the first 20 patients denied all symptoms even after they were awaiting medical discharge.

On account of our interest in this disease, follow-up questionnaires were sent to all men who were found to have bronchiectasis, 37 in all.³ The follow-up period, as mentioned above, has been as long as two years. The cooperation obtained has been so good that it is planned to continue the follow-up after our return to civil life.

Most of those who denied symptoms while in training now have some cough and expectoration of sputum. It is probable that their earlier denial of symptoms was made in the hope that they could remain in the air forces and continue flying training. Information was received from 36 men, as follows:

Number heard from.....	36	(100%)
Dead.....	1	(2.8%)
Lobectomy.....	2	(5.6%)
No symptoms.....	8	(22.2%)
With symptoms.....	25	(69.4%)
Slight.....	12	(33.3%)
Moderate.....	8	(22.2%)
Severe.....	5	(13.9%)
Cough.....	25	(69.4%)
Expectoration.....	25	(69.4%)
Hemoptysis.....	$\frac{1}{2}$	(1.1%)
Unable to do satisfactory work.....	5	(13.9%)

One death from empyema is described in the case reports (Case II). Of the 8 men with no symptoms, one was reinducted by his draft board and according to his medical officer is non-symptomatic and performing full military duty in a satisfactory manner. Unilateral lobectomies were done in 2 instances, and both patients report no symptoms. Concerning those

with symptoms, 12 report that these are so slight as to be unnoticeable; 5 state that they feel well enough to perform their daily tasks in a satisfactory manner, though they have some cough and expectoration. The 5 men who are classified as severe cases have lost weight and are unable to work regularly. Despite this, only 3 are under a physician's care; none has consulted a thoracic surgeon though this has been urged. Generally those with symptoms agreed that crash work in a dry climate seemed to relieve them. Cough and expectoration were noticed principally on retiring at night and on awakening.

Much discussion has arisen regarding the role of sinusitis in the causation of bronchiectasis. Since some of the men were not studied from this point of view, no dependable conclusions can be drawn.

CASE REPORTS

CASE I: This man, aged 24, was the only one who had a definite antecedent history. He was admitted to the hospital because of a small area of infiltration (Fig. 1, A) in the right lower lobe which was thought to represent some residual pneumonia. There was an adjacent small area of decreased density, but this was not considered of any significance. Inquiry disclosed that the patient had aspirated a seed when eight years of age and coughed it up eight years later. He stated that he very occasionally coughed up some "yellowish" sputum. Lipiodol was instilled, and roentgenograms revealed localized cylindrical bronchiectasis in the right lower lobe posteriorly (Fig. 1, B). Follow-up history after discharge shows the condition unchanged; symptoms are slight.

CASE II: A man, aged 22, was admitted to study because of increased peribronchovascular markings and areas of lessened density in both lower lobes (Fig. 2, A). He stated that he had a chronic cough with slight expectoration during the winter months. Bronchiectasis was suspected. A bronchogram revealed bilateral cylindrical bronchiectasis in both lower lobes (Fig. 2, B), and the patient was discharged from the army. Follow-up studies revealed the occurrence of violent headaches six months after discharge. An empyema subsequently developed and then, while the patient was in the hospital, hemiplegia ensued. Death occurred six months after discharge. No necropsy was done.

CASE III: A tool and die maker, aged 24, had been in the army two years. His past history was negative and he denied any symptoms. Roent-

³ The four cases discovered at B. T. C. No. 10, Greensboro, N. C., could not be followed.



Fig. 1. Case I. A. Small area of infiltration in right lower lobe, with adjacent area of emphysema. B. Localized bronchiectasis in right lower lobe, revealed by lipiodol injection. (NOTE: B is unfortunately reversed left to right.)

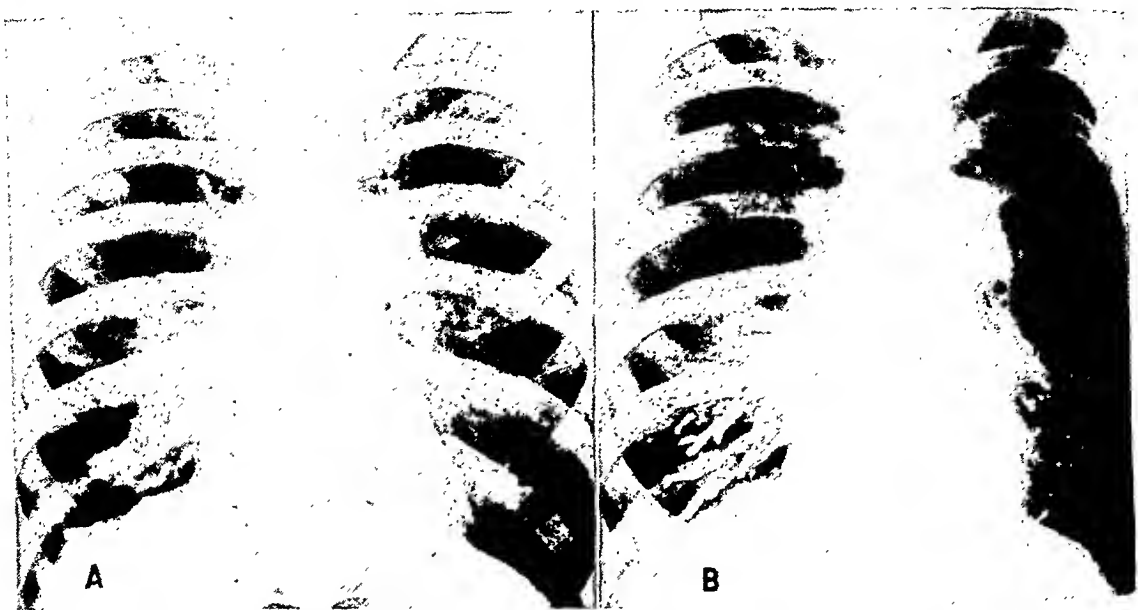


Fig. 2. Case II. A. Accentuated peribronchial markings and infiltrations in both lower lobes. B. Bilateral cylindrical bronchiectasis.

chest films disclosed increased peribronchial markings with infiltration extending out from the left cardiac border (Fig. 3, A). Ring-like shadows with increased transparency were noted. A bronchogram was made, which revealed extensive bilateral cylindrical bronchiectasis with some sacculations (Fig. 3, B). Films made at another station one year earlier showed the same findings, so that it is probable that the disease existed prior to enlistment. The patient was discharged from the army. His reply to our subsequent questionnaire stated that he had lost 20 pounds in weight and was unable to resume his previous occupation. It is probable that he had symptoms before but had concealed them.

CASE IV: This patient, aged 23, stated that he had slight cough and expectoration. Roentgen examination disclosed a prominent left hilum and increased peribronchial markings with slight infiltrations extending to the base (Fig. 4, A). A bronchogram revealed diffuse cylindrical bronchiectasis (Fig. 4, B). The condition remains unchanged. The patient states that his symptoms are so slight that they are barely noticeable.

CASE V: This patient, aged 21, gave a history of four attacks of pneumonia since February 1943. He had a chronic cough with a daily expectoration of about 150 c.c. of greenish sputum. A bronchogram in April 1944, at his station hospital, disclosed cylindrical bronchiectasis of the left lower lobe. Transferred to a general hospital for more definitive treatment, with bed rest and postural drainage, he had made such progress that operation was postponed, especially as repeated bronchograms showed decrease in bronchial dilatation. The patient was sent to our hospital here for convalescent care.

Though a bronchogram still shows some dilatation, his condition at present is very good. He has practically no cough or sputum, has regained his lost weight, and has been returned to duty. Although not included in the series of 41, he will be followed, as his case is of interest. His induction film could not be procured.

ROENTGENOGRAPHIC FEATURES

In the course of this survey of 156,000 chest roentgenograms, 638 men were found to have non-tuberculous infiltrations, the larger number of whom had these findings in one or both lower lobes. These men were admitted to the hospital, where it was found that the majority had no symptoms or relatively minor ones. It was thought that many of the cases were instances of atypical pneumonia. There were only about 8 patients with lobar consolidation. In most instances the findings cleared at the end of two to three weeks. There were, however, approximately 100 cases in which the infiltrations persisted, where there were noted accentuations of the peribronchial markings, ring-like transparent shadows, or some recent pleuritic reaction. As we became more aware of bronchiectasis, these findings assumed more importance, so that it became almost a routine to obtain a



Fig. 3. Case III. A. Veil-like infiltration extending out from left cardiac border.
B. Diffuse fusiform bronchiectasis in both lower lobes.

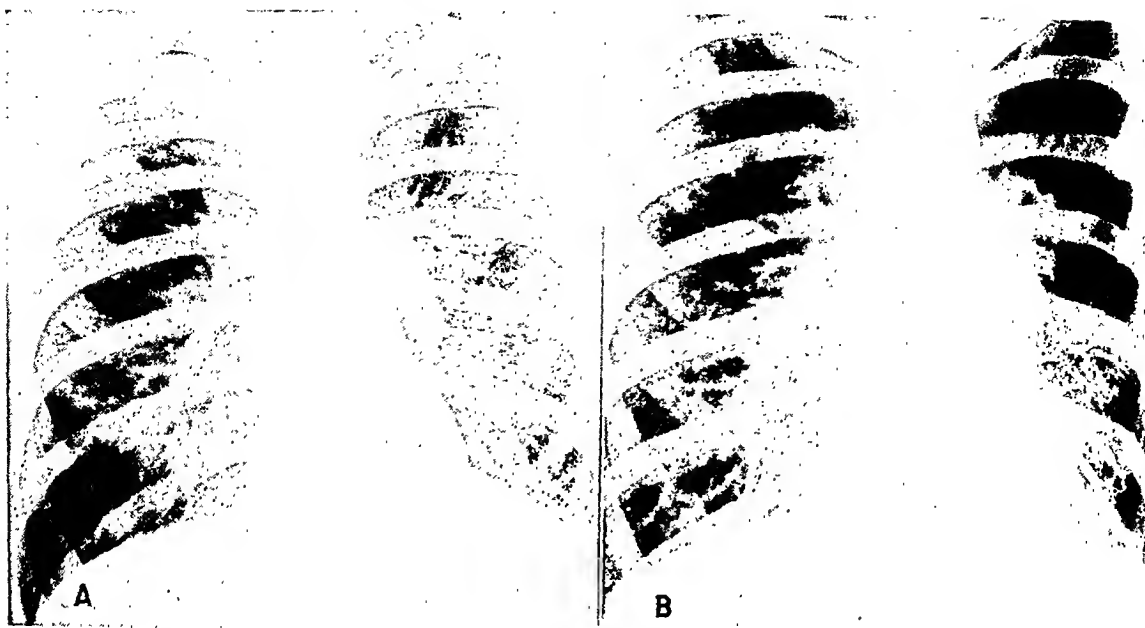


Fig. 4. Case IV. A. Prominent left hilum; accentuated peribronchial markings with infiltration and recent pleuritic involvement. B. Cylindrical bronchiectasis in left lower lobe.

bronchogram⁴ when they were encountered.

ROENTGENOGRAPHIC FINDINGS IN 41 CASES

Accentuated peribronchial markings.....	39
Basilar infiltrations.....	31
Ring-like transparent shadows.....	15
Diaphragmatic changes.....	10
Atelectasis (lobar).....	1
Suspected before.....	17
Left lower lobe.....	12
Right lower lobe.....	19
Bilateral.....	10

COMMENT

The term "suspected before" in the accompanying tabulation implies that the diagnosis was made at the first examination, before hospital admission.

There were four men who showed some dilatation of one or two bronchial radicles or had an isolated dilatation. These were not included in the above total. In one case a bronchogram was made at another army hospital, showing slight expansion in the caliber of the bronchial lumen. A diagnosis of early bronchiectasis was made and the soldier was transferred here for a flying examination. A bronchogram ob-

⁴ The method used is relatively easy. The throat is sprayed with 2 per cent butyn sulfate solution. When anesthesia is complete, the tongue is pulled out, and lipiodol dropped on the back of it by means of a curved cannula and syringe, the patient being tilted to one or the other side.

tained here confirmed the earlier findings. Evans and Galinsky (3) describe similar cases and raise the question whether these persons will go on to show progressive bronchial dilatation or whether the process is arrested and will finally disappear. It was decided to allow these men to continue an army career after close questioning revealed that they had no symptoms and were well. That this was not an unwise decision is attested by the fact that 8 men continue to deny any symptoms while 12 state that symptoms are so slight as to be almost unnoticeable. Of interest in this connection are the 6 cases described by Blades and Dugan (5). In their patients bronchial dilatations followed atypical pneumonia. Re-examination, two to three months later, showed the bronchial dilatation to have disappeared. Blades and Dugan consider these cases of pseudo-bronchiectasis. They estimate that approximately three months are required for the bronchi to return to normal and suggest that cases of bronchiectasis following pneumonia be re-examined. Since all our patients were discharged from the service soon after the diagnosis was made or were sent to general hospitals for disposition, only three men could be re-

examined, with no change observed. We have encountered one case which somewhat resembles those described by Blades and Dugan except that the dilatation has not completely disappeared (Case V).

As to the relationship of atypical pneumonia and bronchiectasis, Campbell *et al.* (6) have suggested that in cases of atypical pneumonia which are slow to undergo resolution and have some associated atelectasis, bronchiectasis may develop. In order to be certain that this is the case, it would seem that any films made prior to the onset of the pneumonia should be obtained, for the patient might have had coincident bronchiectasis. Four of our patients attributed their disease to a previous pneumonia. Since it was not possible to obtain induction films, three could well have been cases of bronchiectasis with a pneumonic complication. In the fourth man bronchiectasis appears to have developed following pneumonia. Two cases are of particular interest. One man who had extensive pneumonic involvement with atelectasis and subsequent cough and expectoration was found to have bronchiectasis here about five months later. The other, who had an extensive pneumonia, had a bronchogram made at another hospital shortly after the pneumonia resolved. Since he continued to have cough and expectoration, bronchography was repeated four months later, when it revealed bronchiectasis. The bronchogram made elsewhere was obtained. Comparison showed that definite dilatation of previously normal bronchi had occurred. It would appear, therefore, that bronchiectasis may follow an extensive pneumonia. This is probably an infrequent occurrence, however, for at this station over 1,000 cases of pneumonia have been diagnosed roentgenologically, the majority of which were considered clinically to be atypical pneumonia. In 18 cases with findings persisting for four to six weeks, bronchograms were obtained. None showed any bronchial dilatation. It is hoped that others will investigate this important question.

PROGNOSIS

The ultimate prognosis in these cases has occasioned considerable discussion. It would be hazardous to make any predictions at this early stage, but the fact that 20 (77.7 per cent) of the 36 men followed have few or no symptoms is very encouraging. Six men are still in the army and are all doing satisfactory work, with 2 denying any symptoms. Two men (5.5 per cent) have had lobectomies and are well; one (2.8 per cent) has died.

A recent *Army Medical Bulletin* concerning the handling of cases of bronchiectasis suggests that discovery of minimal bronchial dilatation without symptoms should not be cause for dismissal from military service. That this policy is sound seems to be confirmed by the experience recorded here.

CONCLUSIONS

1. Forty-one cases of bronchiectasis were discovered during routine chest surveys of 156,000 candidates for flying training.

2. All of these men had been able to perform full military duty. Follow-up studies of 36 have revealed that 77.7 per cent have minimal or no symptoms.

3. Since symptoms are slight, patients with slowly resolving basal pneumonia or peribronchial infiltrations are entitled to bronchographic studies.

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Roentgenograms of the Chest in Mental Deficiency¹

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ROENTGENOGRAMS of the chest in the feeble-minded are of the greatest importance, since lesions of the heart and lungs cause a larger number of deaths in this group than all other causes combined. Because we, as roentgenologists, are not usually on the professional staffs of institutions for the feeble-minded, we may be somewhat unfamiliar with them. In order to give a clearer conception of the mental level of the persons about whom this paper is written, an I. Q. classification is given which is used by many writers.

Genius.....	Above 140
Very superior.....	120-140
Superior.....	110-120
Normal.....	90-110
Borderline.....	70- 80
Feeble-minded.....	Below 70
Moron.....	50- 70
Imbecile.....	25- 50
Idiot.....	Below 25

Feeble-mindedness may be defined as a condition characterized by a lack of normal development of the intelligence. It may be due to damage of the brain substance by disease or injury and may occur before birth, during labor, or during the first six years of life. It may also be due to an imperfect development of the brain structure.

The highest type of mental defective is the moron, whose mental age is from seven to twelve years and whose intelligence quotient is from 50 to 70. When physically able, the moron may do any type of labor where the mental requirement is not too great. The next type is the imbecile, whose mental age is from three to seven years and whose intelligence quotient is from 25 to 50. The higher-grade imbecile may do small, simple tasks, but the capacity of the lower grades

in this group is so limited that they are unable even to care for themselves. The lowest group comprises the idiots, whose mental age is three years or less. They are helpless and must be cared for entirely.

The mongolian has certain characteristics which set him apart from all other mental defectives. He may fall into any one of the three groups mentioned, so far as his mentality is concerned, but he is most commonly found in the imbecile group. In addition to being a mental defective, he has certain distinguishing physical characteristics. These are slanting eyes, weak muscular structure, and a peculiar crook of the fifth digit of the hands. His resistance to any type of infection is extremely low.

The Polk State School, where the material for this paper was studied, has over 3,000 inmates, 18 per cent of whom are morons, 67 per cent imbeciles, and 11 per cent idiots. About 200 of these inmates are mongolians.

The roentgenogram of the chest of the healthy moron is no different from that of a healthy normal individual. The appearance of the chest in non-tuberculous infection is also much the same. The amount of perivascular markings is about that usually seen, increasing when upper respiratory tract infection is present. Morons do not have a higher incidence of tuberculosis than is usual among mentally normal persons but they exhibit a different reaction to tuberculous infection. What has been said of the moron is true also of the high-grade imbecile. In the low-grade imbecile and idiot, there is a marked change in the lung findings, a much larger amount of perivascular infiltration being seen. This is present throughout the lungs, most marked in the

¹ Presented at the Joint Meeting of the American Roentgen Ray Society and the Radiological Society of North America, Chicago, Ill., Sept. 24-29, 1944.

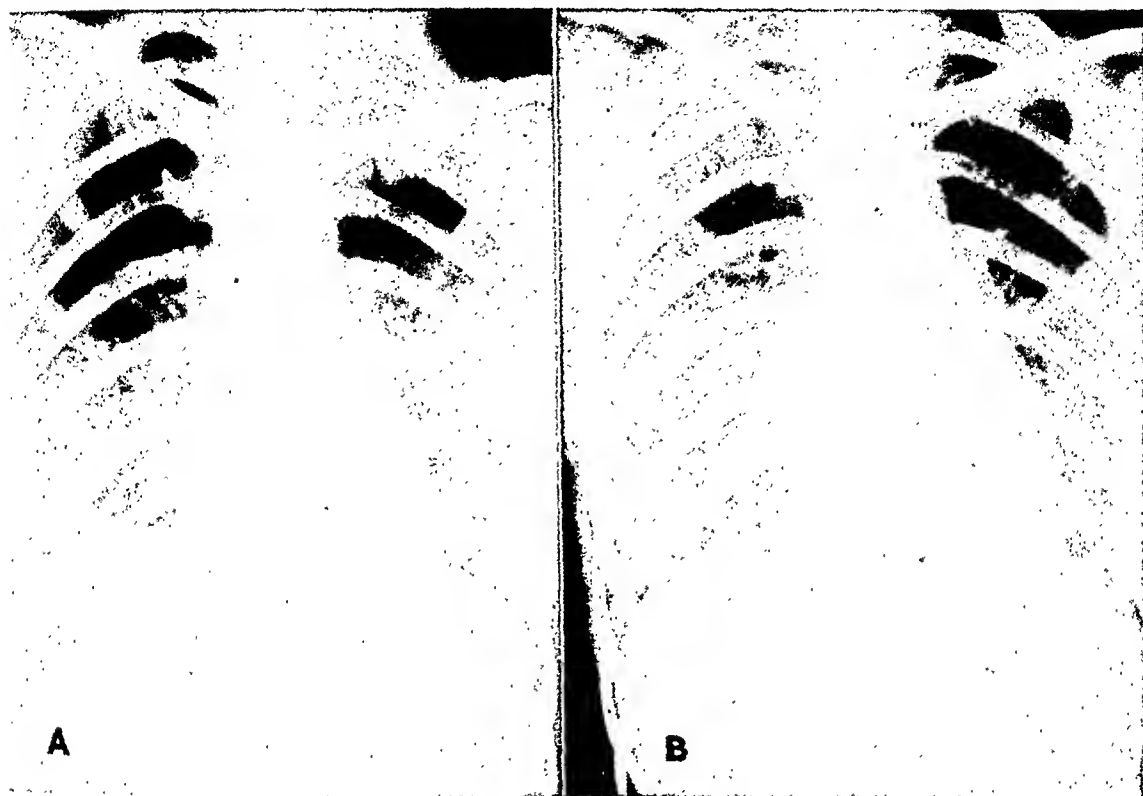


Fig. 1, A and B. Case 1: R. T., female, age 16 years, a high-grade idiot, on her first examination (A) showed a small amount of parenchymatous change in the left apex. The large amount of perivascular infiltration seen in both bases is normal for persons in the low-grade imbecile and idiot groups. The film made ten days later (B) shows extensive progress of the activity, so that now the lower two-thirds of both lungs are involved.

bases. Mottled areas of congestion may be seen in any portion of the lower two-thirds of either lung. In making a diagnosis on a chest film, one must know whether the inmate is a moron, imbecile, or idiot, since the amount of lung markings that would be normal for an idiot would be definitely pathological in the moron.

The reason for this increase in lung markings is open to conjecture. One of the causes advanced is the fact that the low-grade imbecile and idiot have a very high cough threshold. They will cough if irritation is severe, but the presence of phlegm or mucus in the upper respiratory tract gives them no concern whatever and they make no attempt to get rid of it. Consequently, the phlegm and mucus may stay in the respiratory tract for a long period of time. Some of these patients lead very sedentary lives. Their mentality is such that all they can do is sleep and eat. A normal subject, when put to bed, shows more lung markings than usual,



Fig. 1, C. Case 1. Film taken one month from the time of the first examination, showing an advanced tuberculosis of both lungs. Death occurred seven weeks after the first x-ray examination.

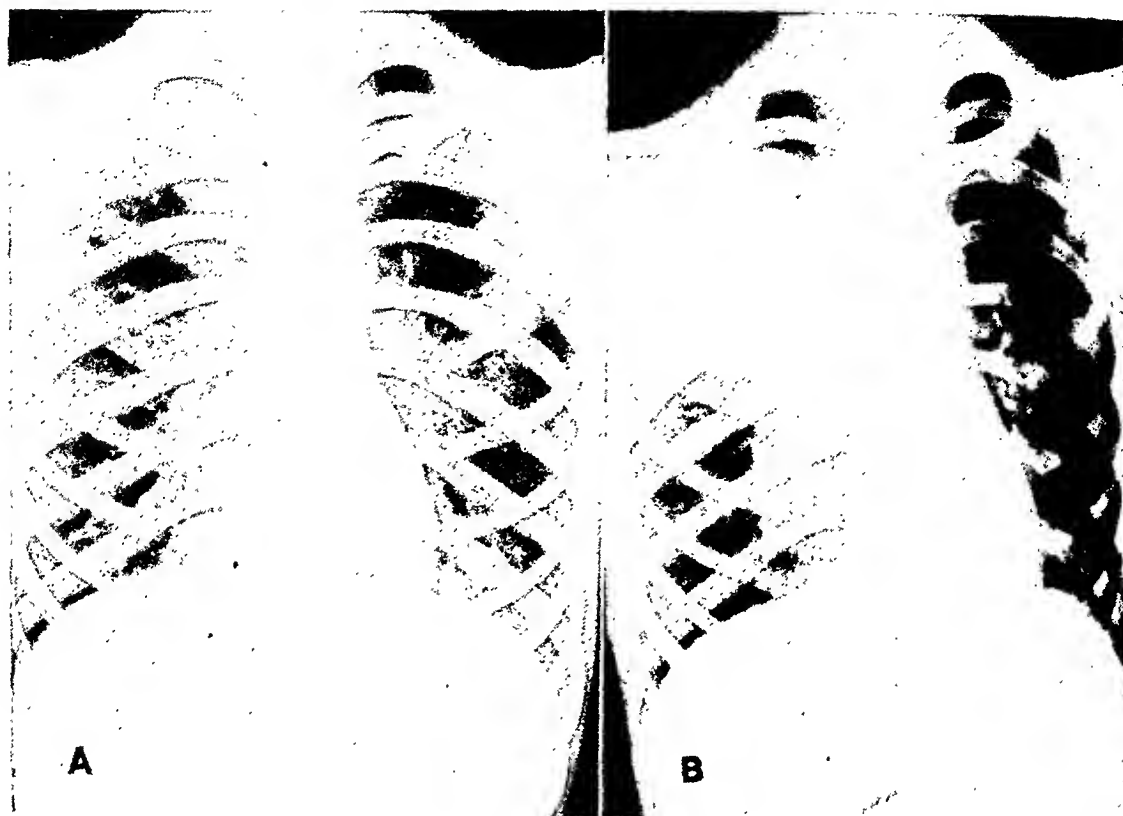


Fig. 2, A and B. Case 2: S. W., male, age 13 years, a high-grade idiot who attended school. A. Because of the patient's higher mentality, he does not show the perivascular infiltration in the bases seen in Fig. 1, A. Sign of an acute chest condition developed, and on x-ray examination a right upper lobe pneumonia was found (B).

and it is logical to suppose that some of this perivascular infiltration is due simply to inactivity. Some of the inmates in the low-grade groups are quite active and it would appear from our chest studies that the greater the amount of activity the less the perivascular infiltration and congestion. The musculature in the more apathetic cases is very flabby, and this gives the roentgenogram an unusual appearance. The lateral portions of the chest show band-like shadows of the latissimus dorsi and pectoral muscles and, because of the lack of muscular density, the upper and outer thirds of the lung show much greater penetration than is usually the case in healthy persons.

Mental deficiency is many times associated with body deformity, and we have numbers of cases of deformity of the thoracic cage causing a change in the lung findings on x-ray examination. Atelectasis, congestion, and chronic infection may be seen in the lungs as a direct result

of thoracic deformity. Interference with the pulmonary circulation may be of such a degree that death may occur as a result of right cardiac dilatation. Spastic paralysis may cause difficulty in breathing due to the fact that some of the muscles of respiration are affected. There is an increased amount of infiltration in the lungs of these patients which roughly corresponds to the degree of paralysis in the muscles of the chest. Most of these spastics are low-grade imbeciles and idiots and consequently the amount of perivascular infiltration would be even greater. In spite of their deformities, the incidence of acute pulmonary disease in this group is no greater than is usual among the other inmates.

One finding which I believe is seen only in mental defectives is marked air swallowing. These patients will swallow huge amounts of air, filling the stomach and small and large bowel. The air pushes the diaphragm upward, causing a compression of the lungs.

One of the unusual observations about all mental defectives, be they moron, imbecile, or idiot, is that, if tertiary tuberculosis occurs, they have no resistance to it whatever. Almost all inmates show evidence of the primary complex. The usual Ghon's tubercle is seen along with calcification in the hilar regions. The amount of calcification, however, is never very great. No case of secondary tuberculosis was seen at the Polk State School.

Tuberculosis of the tertiary type is usually seen in the early teens. It is very difficult to detect, first because in many instances the mentality of the patient is such that he is unable to speak or does not have the mental capacity to say that he is not feeling well. The first sign may be noticed by an attendant, who finds that the inmate is more listless than usual and probably has a poor appetite. There may or may not be a rise in temperature. As elevation of temperature is a fairly common occurrence in this group, it would not, in itself, lead one to suspect tuberculosis. With the vague symptoms described and with no history obtainable, a diagnosis is practically impossible without an x-ray film. The first film may show no evidence of tuberculosis. If the patient continues to show symptoms, a progress film is usually made in about two weeks. This may show the beginning of the disease. Parenchymatous involvement is usually seen in the lower portion of the upper third of the lung and, as a rule, it advances very rapidly. It may be seen in both lungs on the first examination. Fibrosis seldom occurs and is never extensive. Cavities are common and in the early stages are difficult to detect because of the soft mottled type of infiltration. If the patient lives over three months, very large cavities involving the upper portions of both lungs are commonly seen, the walls around them being extremely thin.

Another common occurrence is an acute pneumonic consolidation of the upper lobe. If the film is taken early in the disease, one cannot tell the difference be-



Fig. 2, C Case 2. A film taken two weeks after B, showing extensive involvement of the entire right lung. Death occurred two months after the beginning of the illness.

tween tuberculosis and pneumonia. As the disease progresses, the characteristic parenchymatous change becomes evident in other portions of both lungs while the acute pneumonic process is clearing. This type of involvement generally goes on to a fatal termination at a very rapid rate.

A third type is the soft, snowflake-like infiltration of both lungs from apices to bases. This is a particularly fatal type of involvement, the process rarely lasting longer than two months.

Pulmonary hemorrhage is uncommon, only two cases have been seen in the past four years at Polk State School. Both of these were fatal.

The usual length of life of a patient after tuberculosis has been found may not be more than a few weeks. It seldom exceeds six months. The average survival for all cases after tuberculosis has been found is probably around two months. The reason for the lack of resistance to tuberculosis in mental defectives is not known. Several facts, however, regarding



Fig. 3. Case 3. Body deformities, particularly of the thoracic cage are common in the feeble-minded and are sometimes so marked that diagnosis of existing chest lesions is difficult or impossible. In spite of their deformities, however, these persons do not show acute chest conditions more often than the other inmates, and the incidence of tuberculosis is low, as they are not of neuropathic stock.

the selectivity of its occurrence are worthy of mention. For instance, it is unusual to see tuberculosis in association with spastic paralysis. Most of our spastic paralysis cases are due to birth injury and the patients as a rule come from good families. Their presence in Polk State School is due not to heredity but to an accident at birth or the fact that the birth canal was too



Fig. 4. Case 4. Air swallowing is commonly seen in lower imbeciles and idiots. The shadow of the liver disappears and the outlines of the stomach and colon cannot be made out. No ill effects can be noticed from this habit.

small to permit the passage of the fetus without injury. Many of our tuberculous patients, on the other hand, come from families of neuropathic stock. A man with a low I. Q. generally marries a woman with an I. Q. of about the same level. All the children of this union then have a low I. Q., and sometimes whole families will need institutional care. A child of superior intelligence is never born of a union where both parents have an I. Q. which is below the average. These children do not necessarily come from families who have tuberculosis and their utter lack of resistance to the disease when individuals of the spastic type show resistance might suggest an hereditary factor. Our experience with the mongolian has caused us to discard this idea, because the mongolian many times does not come from neuropathic stock, yet his resistance to tuberculosis is so poor that he seldom lives beyond the early teens.

From Jan. 1, 1940 to May 31, 1942, there were a total of 185 deaths at the Polk State School. The leading causes of death were as follows:

Tuberculosis.....	57
Epilepsy.....	36
Bronchopneumonia.....	16
Myocarditis.....	14
Malnutrition.....	12

It is difficult to make any definite statements regarding pneumonia in these cases, since pneumonia, myocarditis, and epilepsy are so closely connected. A patient may have frequent, severe epileptiform seizures which may cause fractured ribs. During the convulsions he may aspirate quantities of foreign material and a pneumonia may develop which may cause his death. Acute chest colds and pneumonia, aside from that seen in epilepsy, are fairly common. The rate of death from these causes has decreased to a considerable degree with the advent of the sulfa drugs. About 30 per cent of all mongolians have congenital heart disease, and a fairly large number of the other inmates also show x-ray evidence of cardiac lesions. These have not had sufficient study to be reported on at this time.

CONCLUSIONS

Roentgenograms of the chest of feeble-minded persons of the lower grades show a definite change from the normal in that there is an increased amount of perivascular infiltration, with mottled areas of congestion.

Deformities of the thoracic cage, lack of muscular development, and unusual habits, such as air swallowing, are factors which may obscure the diagnosis in chest conditions.

There is a characteristic lack of resistance to tuberculosis in the mentally deficient, particularly if the patient is of neuropathic stock. Rapid, extensive involvement of both lungs is seen, with a fatal termination in an average of about two months after the case is first diagnosed.

Cardiac conditions of congenital origin and epilepsy complicate the study of the chest in pneumonia. These conditions merit further study.

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DISCUSSION

(Papers by Fine and Steinhauser and Danzer.)

LeRoy Sante, M.D. (St. Louis, Mo.): It seems to me that a proper evaluation of such a paper as that of Dr. Fine, with such statistics, might be very difficult. Here is a group of men who are anxious to fly; they are young and vigorous. They know that if they complain of any symptoms they will be ousted. I wonder if sometimes they do not minimize their complaints (the symptoms may be slight, at that!) and thereby give the impression that they are really symptomless whereas, as a matter of fact, an older person or a person who was not so anxious to continue with what he was doing might be more apt to mention his disability.

It occurs to me, also, that with chronic sinus infection, chronic pneumonitis occurs particularly in the cardiophrenic regions, and particularly on the right. This may give rise to an appearance which might resemble bronchiectasis roentgenographically but which subsequently might clear up with subsidence of the infection in the sinus. I wonder whether in any of these cases there was any correlation with sinus infection, and how many were confirmed by bronchography. Of course, it would be necessary to demonstrate actual saccular lesions and to follow them for a considerable period of time after the patient was discharged, before a true evaluation could be made.

There is one thing which this presentation shows us, however, and that is, that mass surveys of the chest, carefully done as these were, are of value for the detection of other things than isolated cases of tuberculosis.

Regarding Dr. Danzer's paper on "Roentgenograms of the Chest in Mental Deficiency," our experience in this regard has been limited to the examination of patients of the St. Louis Training School, a school for the feeble-minded conducted by the city of St. Louis. In this limited experience, our findings confirm those of Dr. Danzer. We have not thought of correlating the various degrees of feeble-mindedness with the chest findings; we have just



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The Roentgenographic Appearance of Temporomandibular Hydrarthrosis¹

CAPT. ARNOLD L. BACHMAN,² M.C., A.U.S., and LT. COL. ALBERT L. BERSHON,³ M.C., A.U.S.

THE ROENTGENOGRAPHIC diagnosis of effusion into the temporomandibular joint has only rarely been reported. A comprehensive review of the literature revealed a single case record with accompanying illustration (2).

The temporomandibular joint is a ginglymo-arthrodial (hinge-sliding) articulation between the mandibular condyle and the mandibular fossa of the temporal bone (9, 15). A fibrous disk divides the joint space into two separate compartments. The capsule of the joint is loose and baggy in front, permitting comparatively wide anterior excursion of the condyle when the mouth is opened. More detailed study reveals that the actual articulation is mainly between the anterosuperior part of the condyle and the postero-inferior surface of the articular eminence together with the adjacent anterior half of the mandibular fossa (8, 12, 19). The posterior portion of the fossa is occupied by connective tissue and, often, a small lobule of the parotid gland (4, 12). With the appearance of an effusion, the joint space becomes wider and the increased intra-articular pressure displaces the condyle in the direction of least resistance, *i.e.*, downward and anteriorly where the capsule is loose.

The roentgenographic demonstration of the temporomandibular articulation has offered considerable difficulty. For this reason, numerous reports have appeared on positioning and radiographic technic for the adequate visualization of this joint. Of these technics, the four most commonly employed are as follows: (a) routine lateral view (2, 7, 16, 17); (b) near-distance lateral view (1, 13, 18), in which the target of the tube is placed practically in contact with

the skin of the opposite side in order to obliterate the shadow of the opposite condyle by gross magnification, thus improving visualization of the suspected joint; (c) an anteroposterior view of both joints simultaneously (12), obtained with the subject's head placed in the anteroposterior position on a 35° inclined plane; (d) tomographic studies (3, 11, 14). We have found the first and third of these methods most practical for general routine roentgenography. Reduplication of results is obtainable with satisfactory accuracy. For the routine lateral view, the patient's head is placed in a lateral position on a 20-23° inclined plane, the mid-sagittal line of the face lying parallel with the plane. The ear is not bent forward. The central ray is directed perpendicular to the horizontal. It passes through a point about 2 inches above and an inch and a half in front of the external meatus of the opposite side, and emerges through the suspected articulation. The target-film distance varies between 30 and 36 inches.

In the roentgenograms of the normal joint (2, 7, 8, 18) the mandibular fossa is shallow and the articular eminence appears broad, round, and moderately prominent. The mandibular condyle is elliptical in cross section and is tilted forward. When the mouth is closed, the articulation is mainly between the anterosuperior portion of the condyle and the postero-inferior surface of the eminence. The radiolucent joint space between the condyle and fossa is essentially of uniform width in all portions of the arc (Fig. 2). Occasionally, the anterior portion of the condyle may be slightly closer to the eminence than the remainder of the condyle is to the anterior half of the fossa. However, no marked variation in the width of the space between

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any aspect of the condyle and the fossa or articulating eminence is observed. When the mouth is opened 1 to 2 inches (Fig. 2), the condyle moves downward and anteriorly to a position below and in front of the articulating eminence (10). Examination should be made bilaterally to compare the suspected with the normal joint, particularly for the relationships of the condyle, articular eminence, and mandibular fossa in the view with the mouth closed. Of equal importance is the comparative amount of movement of the condyles when the mouth is opened. Intrinsic osseous changes of the opposing bony surfaces are, of course, also to be noted.

With the presence of an effusion, the joint space is increased in width due to the accumulated fluid, and the condyle is displaced downward and forward. As a result of this displacement, the anterior aspect of the condyle lies closer to the eminence than is normally observed. The uniform width of the joint space radiolucency is thus grossly altered, being increased posterosuperiorly and diminished antero-inferiorly. There is also noted impaired anterior mobility of the condyle when the mouth is opened (Fig. 2).

Effusion into the temporomandibular joint has been reported as occurring in a variety of conditions. These have been grouped as (a) traumatic arthritis; (b) rheumatoid arthritis; (c) suppurative pyogenic arthritis.

Traumatic arthritis resulting in hydrarthrosis may be acute or chronic, the former being a much more frequent cause of the effusion. Acute traumatic arthritis (4, 6) may arise from a blow on the jaw, usually without dislocation, or from excessively forceful opening of the mouth. There may result an acute serosanguineous effusion in the joint, which later becomes serous. Rapid subsidence with disappearance of the fluid frequently occurs. In the absence of healing, however, the tissue congestion may lead to synovial hypertrophy, pannus formation and, eventually, fibrous ankylosis. Symptoms of the acute episode are usually sudden onset of pain and local-

ized swelling and tenderness over the temporomandibular articulation. Pain on motion greatly limits the joint mobility.

Chronic, repeated, mild irritations of the temporomandibular joint have also been described as occasionally causing changes which may result in an effusion (2, 12). The most commonly observed chronic traumatic irritation syndrome, however, internal derangement of the temporomandibular joint, has not been reported as associated with a demonstrable effusion. The findings in this syndrome are mainly those of joint narrowing, bony changes in the mandibular condyle, temporal fossa and articular eminence. Condylar mobility may be increased or diminished when the mouth is opened (3, 5, 7, 8, 13, 18, 19).

Involvement of the temporomandibular articulation, along with other joints, in *rheumatoid arthritis* has been observed with moderate frequency. In the early, acute stage there are periarticular edema, synovial proliferation and, frequently, a serous effusion into the joint (4, 6, 15). Later the characteristic pannus formation, subarticular bony changes, and ankylosis are also seen. Several cases have been recorded in which the inflammatory process in the temporomandibular joint has apparently preceded involvement of other joints by months.

A purulent effusion is, of course, always observed in *suppurative pyogenic arthritis* (4, 6). Suppuration in the joint may result from infected compound traumata such as fractures or perforations by sharp instruments. Less frequently, the suppuration is caused by a gonorrheal arthritis which, when present, usually occurs in the newborn infant as a complication of gonorrheal conjunctivitis. Only rarely has this gonorrheal complication been encountered in adults with urethritis. Temporomandibular pyo-arthritis has been reported as due to extension from contiguous suppurative lesions, i.e., osteomyelitis of the mandible, suppurative otitis media, etc. It has also been described, though rarely, in the course of acute infectious

diseases, as scarlet fever, pneumonia, and typhoid fever.

While effusions in the temporomandibular joint have been noted as occurring in the above described conditions, a careful search through the literature revealed no reports, other than that of Bishop (2), mentioned above, in which the diagnosis of hydrarthrosis was made radiographically. In a general article on the roentgenographic manifestations of temporomandibular articulation abnormalities, Bishop presented one case highly suggestive of effusion, and showed the radiographic appearance with the mouth closed. Unfortunately, as he stated, he did not have the opportunity to re-examine the patient and follow the changes in the joint. Pancoast, Pendergrass, and Schaeffer (12) have included a reproduction of the roentgenogram from Bishop's case in their book.

CASE REPORT

A white enlisted man, age 18, was admitted to the Hospital on June 26, 1944, with severe pain in the area of the right temporomandibular joint and limitation of mandibular movement of eight hours' duration. The patient had been entirely well the evening before, recalling no local or general symptoms. When he arose in the morning the region of the right temporomandibular joint was painful and tender and he experienced difficulty and severe pain on attempting to open his mouth. Mandibular movement was therefore strictly limited. The patient stated that he felt most comfortable when his jaw was protruded forward and to the left. There was no history of a blow, other trauma, or of any recent illness, and the patient had no recollection of yawning or placing his jaw in an unusual position which might have brought on the disability.

At the Dental Clinic, a clinical, tentative diagnosis of possible dislocation of the mandible was made. Mild attempts at reduction were unsuccessful, and the patient was referred to the Hospital.

The previous history was irrelevant. During the past several years the patient had been entirely well. There was no history of arthritic symptoms, dental infections, or dental procedures. Gonorrhea and syphilis were denied.

Physical examination revealed no abnormalities except for the findings in the jaw. The mandible was protruded forward and to the left (Fig. 1). There were localized tenderness and mild swelling over the right temporomandibular region. No increased local heat over the joint was felt. The pa-



Fig. 1. Appearance of patient on admission. Note protrusion of the lower jaw forward and to the left.

tient could open his mouth only slightly, and mandibular movement caused considerable pain in the right temporomandibular joint. Considerable lateral passive mobility of the lower jaw was possible but this also was associated with pain referred to the right temporomandibular region.

There was no fever during the hospitalization period. A complete blood count was normal. An admission sedimentation rate (Westergren method) was 11 mm. fall in one hour.

X-ray examination of both temporomandibular joints was done on July 26, 1944 (Fig. 2). The left temporomandibular articulation appeared normal. The joint space was of uniform width and the apposing bony surfaces of the condyle and the fossa showed no abnormalities. On opening the mouth, the left condyle moved forward and downward for a normal distance to a point just below and slightly in front of the articular eminence. The right temporomandibular joint showed an asymmetrical widening of the joint space, the widening being greatest in the posterior portion of the joint, between the postero-superior part of the condyle and the fossa. The condyle was displaced forward, resulting in a narrowing of the joint space radiolucency between the anterior surface of the condyle and the articular eminence. No intrinsic osseous changes were observed. The open-mouth view showed distinct limitation of condylar movement as compared with that of the normal left side. The condyle lay slightly posterior to the articular eminence.

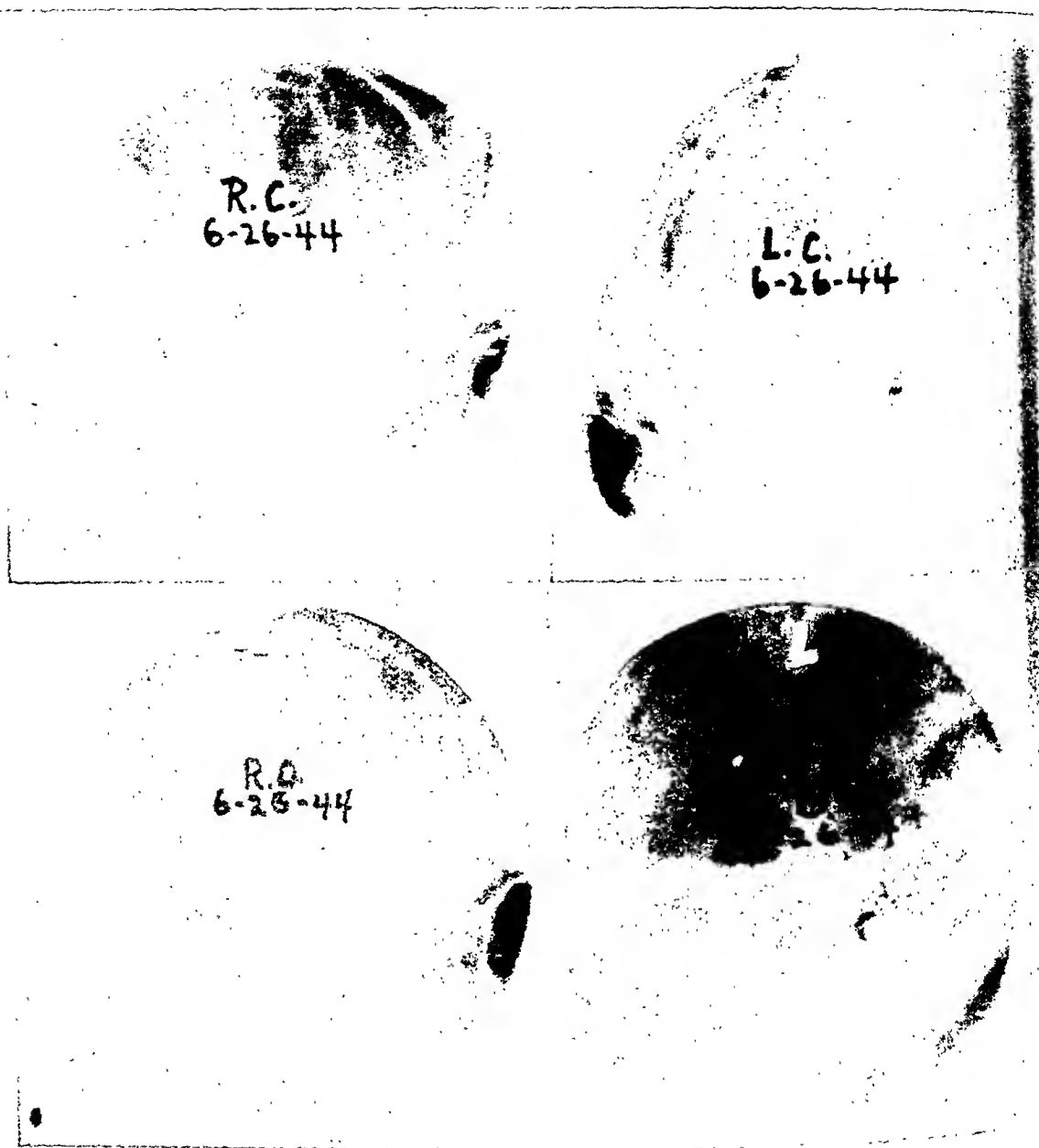


Fig. 2. Appearance of temporomandibular joints on admission, June 26, 1944. R. C. and R. O. Right side in closed- and open-mouth positions. L. C. and L. O. Normal left side in same positions for comparison.

The patient's lower jaw was immobilized with a Barton fixation dressing, and heat was applied locally to the right temporomandibular region. He was placed on a liquid diet taken by tube. With such therapy, local tenderness and pain gradually diminished in two days. On the third day (June 29, 1944), the Barton bandage was removed. At this time there was mild pain only with extreme motion of the mandible; slight protrusion of the lower jaw to the left persisted. Improvement continued, and the patient was discharged the following day with no symptoms and a full range of mandibular movement.

X-ray examination of the right temporomandibular joint on July 1, 1944 (Fig. 3) showed the

joint space to have become normal in appearance with the mouth closed. The asymmetrical increase in the width of the joint space and the anterior displacement of the condyle had disappeared. However, moderate impairment of the movement of the condyle in the open-mouth position was still present.

Two weeks later, there had been no recurrence of symptoms referable to the temporomandibular joint. However, the patient stated that during the past ten days there had been some vague pains in the fingers and wrists. An examination revealed no abnormalities, either there or in the temporomandibular joint. The sedimentation rate was 6 mm. fall in one hour. Radiographic re-examination

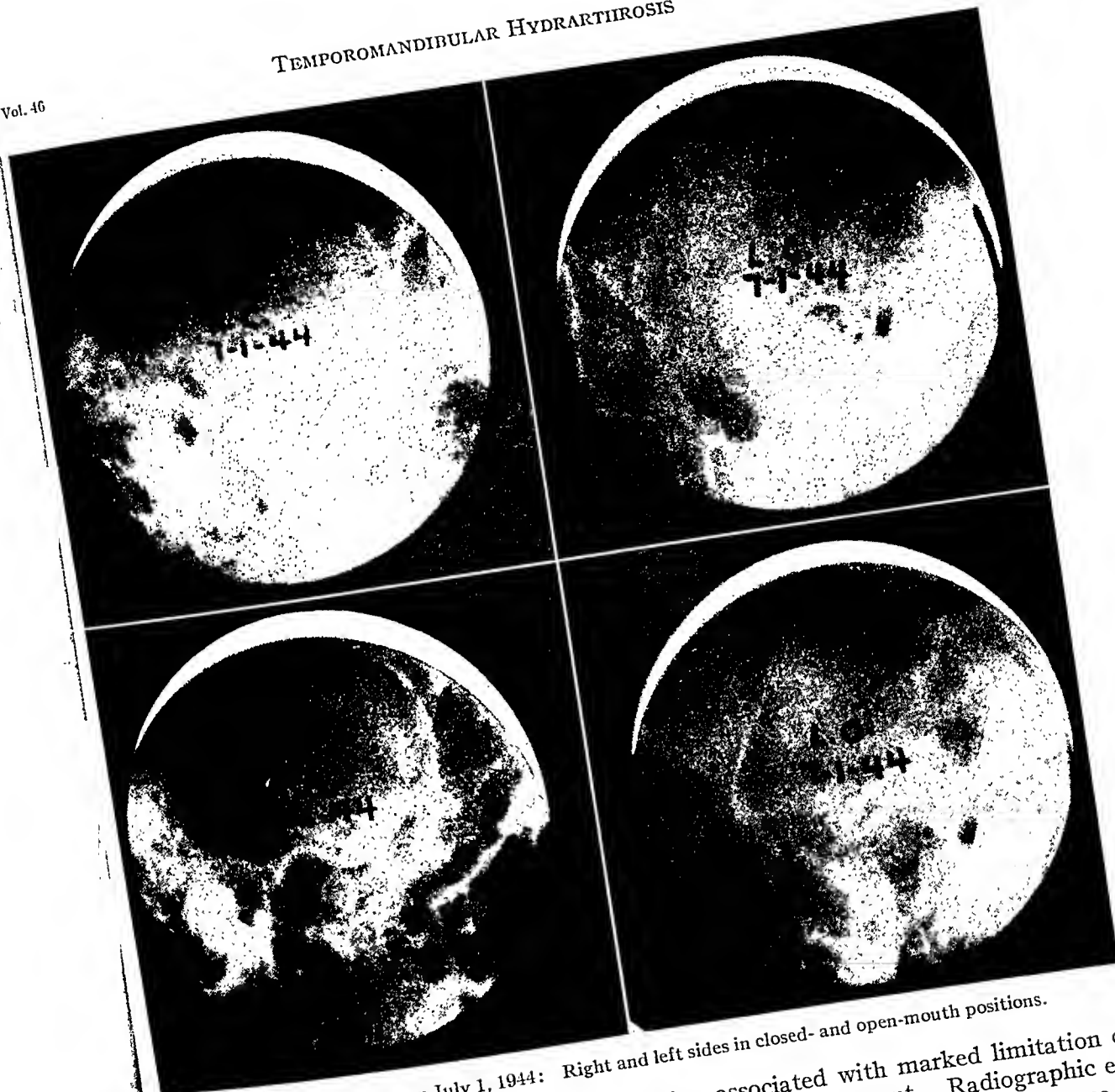


Fig. 3. Appearance on July 1, 1944: Right and left sides in closed- and open-mouth positions.

of the temporomandibular joints on July 13, 1944 (Fig. 4) showed the right articulation to be entirely normal in both the closed- and open-mouth positions. Movement of the right condyle had increased to a normal range and was equal to that of the opposite side. On follow-up examination two weeks later (Aug. 1) all symptoms referable to the jaw, hands, and wrists had completely subsided.

DISCUSSION

A considerable similarity of symptoms exists in cases of acute hydrarthrosis and dislocation of the temporomandibular joint. Thus, in our case and that reported by Bishop (2) there were severe pain and tenderness in the temporomandibular re-

gion associated with marked limitation of mandibular movement. Radiographic examination appears of major importance in the differentiation between effusion and condylar luxation. The necessity for excellent roentgen demonstration of the joint in several views is therefore apparent.

The diagnosis of temporomandibular joint effusion led to conservative treatment with heat and rest, as in any other acute hydrarthrosis. The rapid recovery, observed clinically and roentgenographically, was strong evidence in substantiation of the diagnosis.

The etiology of the effusion in this pa-

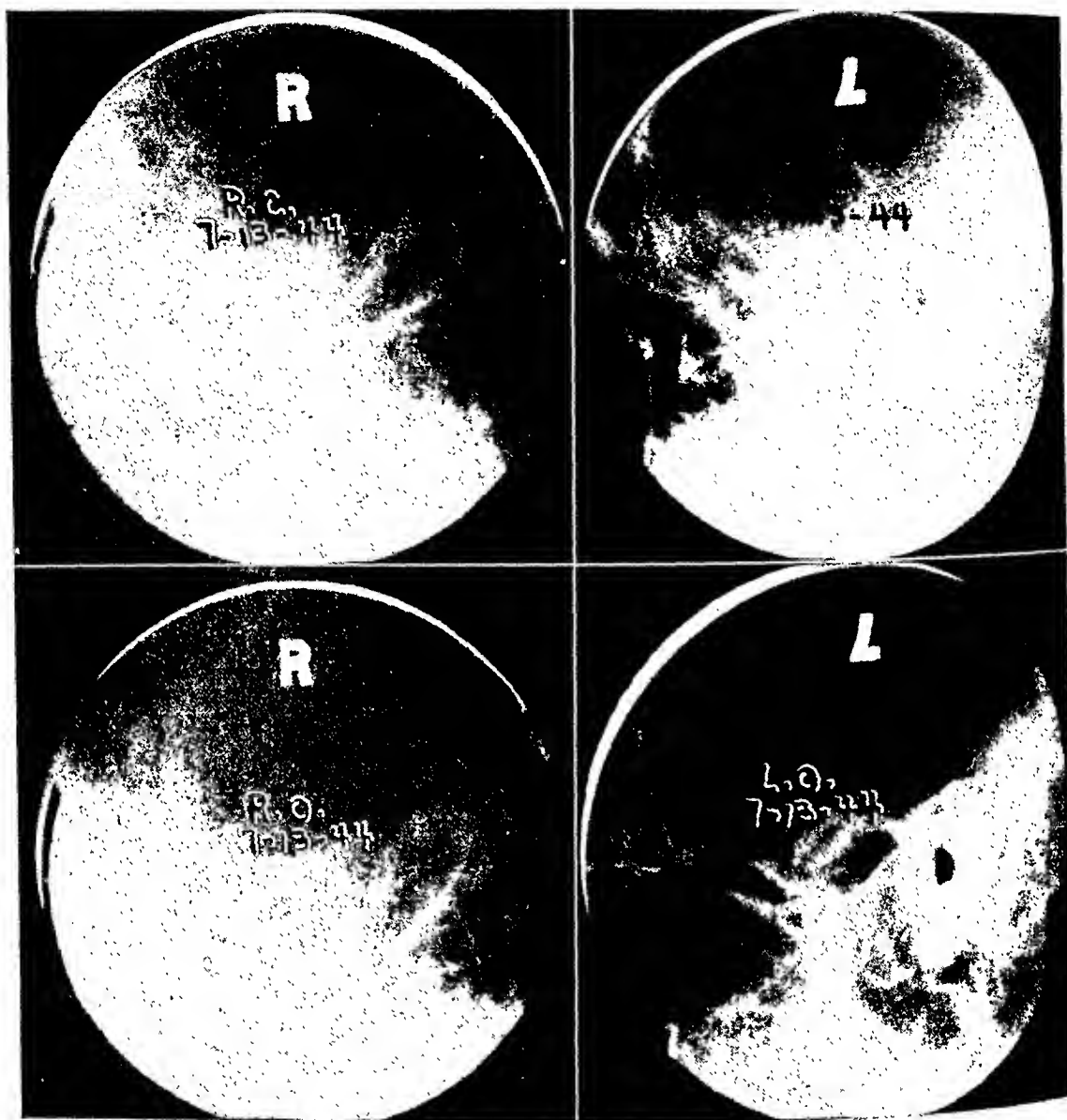


Fig. 4. Appearance on July 13, 1944. The right temporomandibular joint is now normal.

tient is uncertain. Two possibilities appear most worthy of consideration, the others being more or less excluded by the short course of the illness. Although the patient gave no history of any excessive movement of the jaw, the possibility exists that he may have unconsciously moved his mandible into an abnormal position during sleep. The second possibility is that the hydrarthrosis was an early manifestation of rheumatoid arthritis and that other joints may become involved at a later date. This sequence of events has been described by Dingman (6). Our patient did have

mild, vague arthralgias in the fingers and wrists. These symptoms appear of doubtful significance, however, since there were no physical signs of joint abnormality and a sedimentation rate was normal on two occasions. In addition, the joint pains disappeared after a period of about ten days and have not recurred in the two weeks during which the soldier has been under observation. A careful search failed to reveal foci of infection. The patient is being followed while ambulatory to note any local recurrence or development of rheumatoid arthritis.

SUMMARY

1. A case of temporomandibular hyarthrosis is reported.
2. The importance of adequate roentgenographic examination of this joint is stressed.
3. The literature on effusion in the temporomandibular joint is reviewed.

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Transient Successive Pulmonary Infiltrations (Löffler's Syndrome)

MAX EICHWALD, M.D., and WILLIAM V. SINGLETARY, M.D.

IN 1932 Löffler (9) described a transitory pulmonary lesion associated with a high degree of eosinophilia, having a mild clinical course. Since the original publication, many similar cases have been reported. Most writers believe the condition to be a clinical entity and have termed the symptom complex *Löffler's syndrome*.

CLINICAL PICTURE

Löffler's original cases, as well as most of those recorded in the literature, showed rather mild symptoms, such as general malaise, low-grade intermittent fever, and minor upper respiratory complaints. Allergic symptoms and even true asthma are not uncommon. One more severe case with hemoptysis has been described by Barker (1). The significant laboratory findings are eosinophilia up to 69 per cent, as recorded by Smith (14), a slightly increased sedimentation rate, and a normal or slightly elevated leukocyte count.

ROENTGENOLOGIC FINDINGS

The most characteristic and consistent findings associated with Löffler's syndrome are the transitory pulmonary densities found on repeated x-ray examinations of the chest. The first indication of the disease is often discovered on a routine chest film, but the picture is characteristic only if repeated examinations are made during the course of the disease.

The areas of pulmonary density vary considerably in size and contour; they have no characteristic distribution and may be either unilateral or bilateral. The individual lesions are usually sharply demarcated, with irregular hazy borders. The density may be either homogeneous or mottled. The process may extend in various directions to involve the greater

portion of one or more lobes, giving the appearance of consolidation. Similar shadows may appear in any part of the lungs and such recurrences may extend over a period of several months. The initial lesion may be mistaken for tuberculosis, pneumonia, atypical pneumonitis, fungus infection etc., but the transitory character is the distinguishing feature. Complete clearance has been observed by Engel (4) in twenty four hours.

ETIOLOGY AND PATHOGENESIS

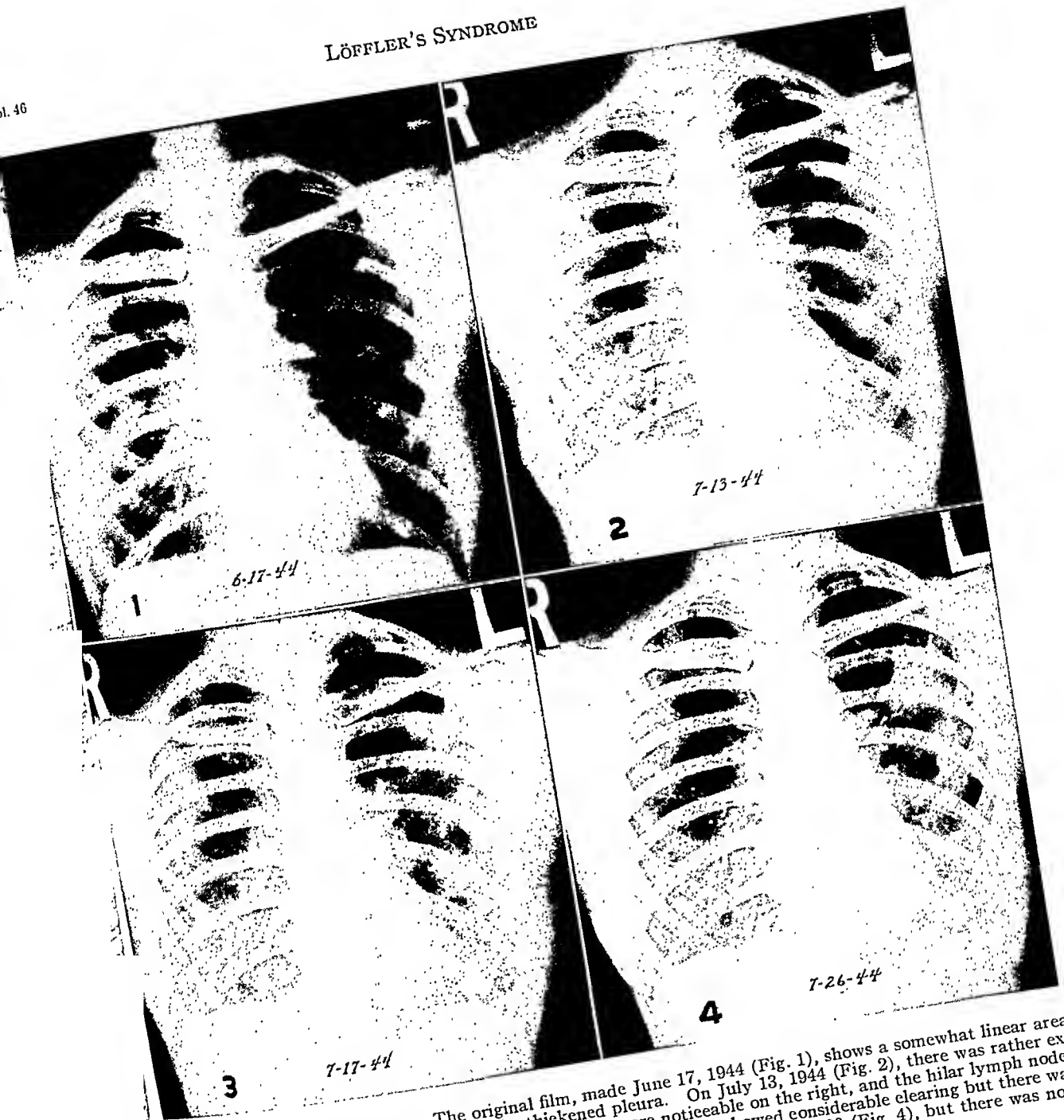
Löffler originally thought that in most of his cases the pulmonary manifestation were on an allergic basis, possibly representing an atypical reaction to tuberculosis. He compared the process with erythema nodosum, where the skin is the mirror of the systemic disease instead of the lung tissue:

The same symptom complex was found by Hoff and Hicks (7) in a case of amebiasis, which presented pulmonary symptoms for more than three months before the diagnosis was established and the patient accordingly treated. Mueller (11) described the syndrome in four physicians who ate salad which came from soil infected with ova of *Ascaris*. He proved the causal relationship by swallowing three teaspoonfuls of the contaminated soil, which produced the same typical symptoms about eight days later. Slowey (12) attributed the condition to an allergic reaction in the bronchi and interstitial tissues of the lung due to *Trichinella spiralis* infection. His case, though clinically not typical of trichiniasis, revealed 100 larvae per gram of deltoid muscle tissue. *Necator americanus* (16) and *Strongyloides stercoralis* (2) are other parasites that are known to cause transient pulmonary infiltrations.

¹ From the Departments of Radiology and Internal Medicine, Watts Hospital, Durham, N. C. Accepted for publication in March 1945.

LÖFFLER'S SYNDROME

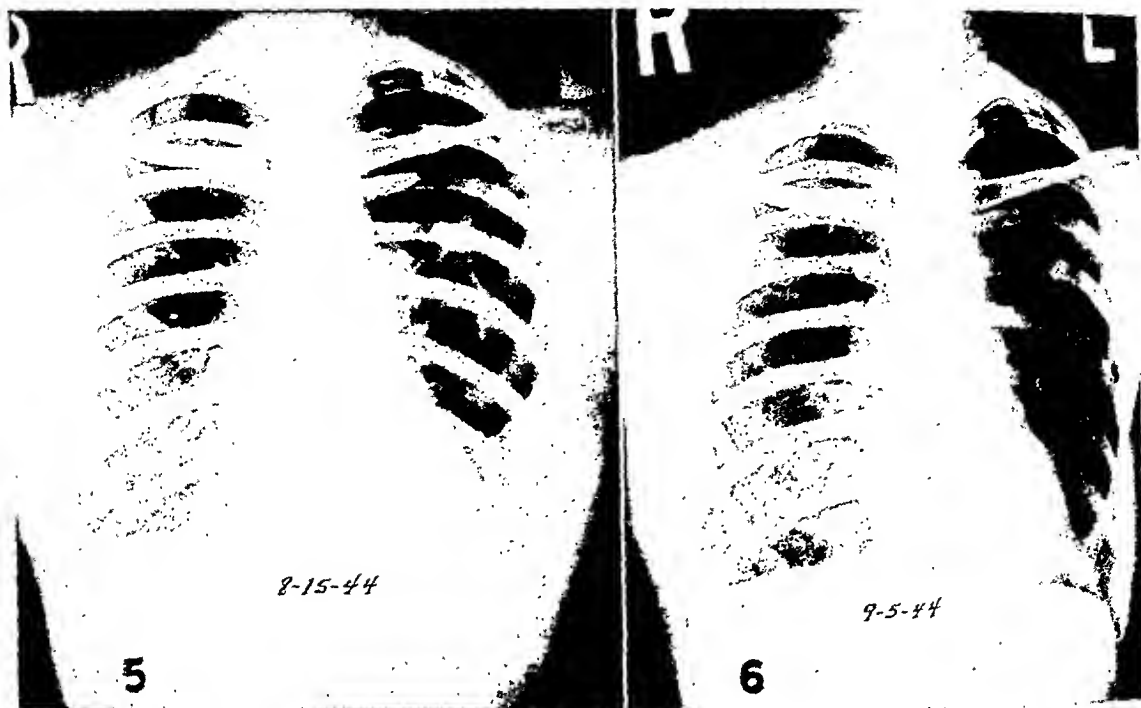
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Figs. 1-4. Löffler's syndrome. The original film, made June 17, 1944 (Fig. 1), shows a somewhat linear area of increased density which was believed to be thickened pleura. On July 13, 1944 (Fig. 2), there was rather extensive irregular mottling in the periphery of each lung, more noticeable on the right, and the hilar lymph nodes were slightly enlarged. On July 17 (Fig. 3), the process on the right showed considerable clearing but there was extension on the left. Still further clearing on the right was demonstrable July 26 (Fig. 4), but there was now mottling throughout the lower four-fifths of the left lung, especially at the periphery.

Elsom (3) reported two cases of chronic brucellosis in which he observed pulmonary infiltrations, a finding not too unusual in that disease. But as they were accompanied by marked eosinophilia, which is not found in brucellosis, he questioned whether or not the combination might represent Löffler's syndrome.

Seasonal incidence was observed by Engel (4) in Shanghai, with epidemic occurrence of mild upper respiratory symptoms. Roentgenograms showed infiltrations of various sizes and shapes which looked very much like pneumonia but disappeared with surprising rapidity. He also found in his cases a high degree of



Figs. 5 and 6. Löffler's syndrome. On Aug. 15 (Fig. 5), the right lung was entirely clear; there was some clearing, also, in the upper portion of the left lung, but some extension in the left base. On Sept. 5 (Fig. 6), the lesion in the left base had completely cleared, but there was some mottling opposite the second interspace anteriorly on both the left and right.

eosinophilia. His conclusion was that the allergic agent was the pollen of the privet plant, the flowering of which coincided with the epidemics.

Transitory pulmonary lesions with eosinophilia have been observed in patients with definite asthma, as reported by Hansen-Pruss and Goodman (5), Soederling (15), and Hansson (6). The following explanation is given in the report by Hansen-Pruss and Goodman: "The allergic pulmonary consolidation is an expression of sensitization to non-specific bacteria . . . it can occur in constitutionally allergic individuals as well as in individuals who acquire the allergic response." Smith and Alexander (13) also stressed the role of bacterial allergen as a causative factor.

Due to the mild nature of the disease, postmortem examinations are infrequent. von Meyenburg (10) had the opportunity of studying four patients who died from accidents or their consequences. He described the infiltrations as being pneumonic in type, with alveolar infiltration and infiltration of the interstitial tissue.

A great part of the cellular elements were eosinophils. The pleura and the interlobar fissures showed inflammatory involvement.

The following case came under our observation, and we felt justified in classifying it as Löffler's syndrome.

CASE REPORT

Mrs. L. L. B., 49 years old, white, a patient of Dr. William Watkins, was admitted to Watts Hospital on June 15, 1944, for a minor female disorder. The family, marital, and past history, and the system review were not contributory to the present discussion. There were no tuberculous or allergic manifestations either in the family or in the earlier history.

About one year prior to admission, the patient began to experience menorrhagia and metrorrhagia, which continued through the following months and increased during the five weeks previous to admission. She was somewhat nervous, suffered occasional malaise, and once in a while had a slight upper respiratory complaint, but never felt actually ill.

The patient was well developed and well nourished; she looked somewhat tired but was in no distress. The temperature on admission was 100.2° F., pulse rate 84, respirations 20, and blood pressure 115/75 mm. Hg. The physical examina-

tion revealed no serious abnormalities other than the pelvic findings. The uterus was twice its normal size and retroverted. The left ovary was a little enlarged and tender to palpation. Inspection of the cervix revealed a polyp protruding from the external os. There was some leukorrhea, and examination of the discharge showed mixed bacteria. The laboratory findings were of no significance except for the blood count, which was as follows: 3,850,000 red blood cells; 12.2 gm. hemoglobin; 3,900 white cells, with a differential count of 45 per cent polymorphonuclears, 21 per cent eosinophils, 33 per cent lymphocytes, and 1 per cent monocytes. On account of the eosinophil count the stool was examined, but no parasites or ova were found.

During the nine-day stay in the hospital the temperature fluctuated between normal and 100° F. Repeated blood counts showed no change in the red picture, but there was an increase in the white count to 10,000 with a drop in the eosinophils to 6 per cent.

On the fifth hospital day the polyp was removed, the uterus was curetted, and a coization of the cervix was performed. The pathologic examination failed to show any malignant change.

A routine chest film showed an area of increased density in the lower portion of the right lung field, which was somewhat linear in contour. This was interpreted as thickened pleura (Fig. 1). As the patient felt rather well, she was discharged on the tenth day after admission.

Two weeks later the patient was readmitted to the hospital. She had experienced a slight elevation of temperature every afternoon since her discharge, occasionally preceded by a mild chill. She did not feel well but was not incapacitated. Her appetite was poor. She was somewhat nauseated and vomited once. Occasionally she had muscle aches in the back and legs. She had no pulmonary symptoms. Physical examination revealed nothing of obvious significance except for some drainage from the external os of the uterus, which was thought to be due to a residual endometritis. This was believed to be responsible for the complaints, and sulfadiazine was given. Re-examination of the chest now showed rather extensive irregular mottling in the periphery of both lungs, more so on the right, and the hilar lymph nodes were enlarged (Fig. 2.). Our impression was that this was an atypical pneumonia but that tuberculosis or fungus infection should be considered. Blood counts were repeatedly done, invariably showing a slight leukocytosis with eosinophilia up to 29 per cent. Blood smear for malaria was negative. Repeated stool examinations failed to reveal either parasites or ova. Agglutination tests for typhoid and paratyphoid organisms and *Brucella* were negative.

All through her second stay in the hospital the patient showed subfebrile temperatures every afternoon. Repeated chest films showed that the pneumonic process did not respond to sulfadiazine or to penicillin (Figs. 3 and 4).

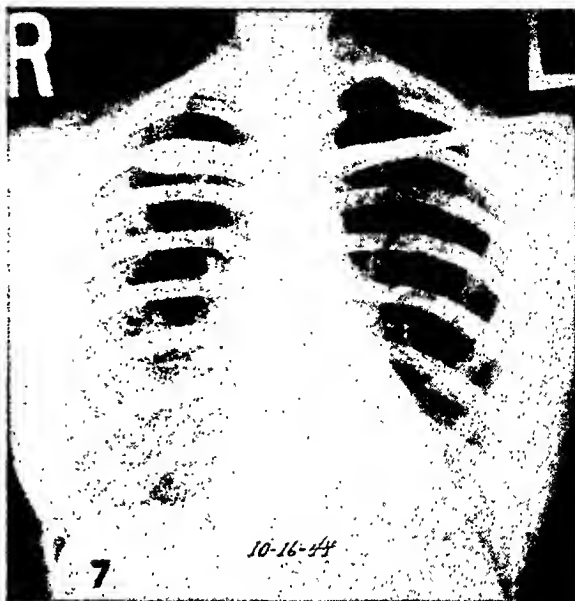


Fig. 7. Löffler's syndrome. Complete clearing, Oct. 16, 1944.

The patient was discharged seventeen days after admission, since she subjectively felt very well despite the fact that the pulmonary lesions were still present. During the following weeks she came back to the X-Ray Department for repeated chest examinations, which showed a definite migratory character of the lesions (Figs. 5 and 6). On one of her visits a *Trichinella* extract skin test was done and found to be negative. The last chest film, taken Oct. 16, 1944, showed the lungs to be clear (Fig. 7). At that time, the patient told us that until a week previous to this she had been running a low afternoon temperature, up to 100° F.

DISCUSSION

We are dealing with a clinical picture which presents a mild course, shows fleeting, successive, often multiple pulmonary lesions, and which terminates, as a rule, rather soon in complete restoration to normal. There is also present a varying degree of peripheral blood stream eosinophilia.

The case presented showed all the typical clinical, laboratory, and roentgenologic features previously mentioned, but the etiologic agent was not definitely determined. The responsible antigen was probably of bacterial origin, possibly from the chronic cervicitis and endometritis.

One must conclude that there are many and varied agents which might be responsible for an allergic pulmonary re-

sponse. This may be set in motion by a systemic allergen, as in bacterial or pollen sensitivity, or it may be a local manifestation, such as is seen in the presence of *Ascaris* larvae in the lungs.

Since the pulmonary shadows are generally due to a secondary allergic response, it is permissible to compare them with the "id" reaction of the dermatologist. We venture to call the pulmonary manifestation a "pneumonid."

The difficulty in establishing a definite diagnosis in some instances is rather obvious, as is well demonstrated by five cases reported by Karan and Singer (8) which were mistaken for tuberculosis. Unless the radiologist realizes the importance of co-operating with the clinician, he may well miss the diagnosis. We again wish to stress the importance of serial films in order to demonstrate the fleeting and migratory character of the lung lesions. Without this characteristic feature, a diagnosis is impossible.

SUMMARY

1. Löffler's syndrome is a clinical entity characterized by a mild clinical course, eosinophilia of high degree, and transitory pulmonary lesions.

2. Repeated x-ray examinations are essential to the diagnosis.

3. The underlying condition is an allergic response of the sensitized tissues (lung) to various agents.

4. A case of Löffler's syndrome is presented which is thought to have been due to a bacterial antigen.

5. The suggestion is made that the pulmonary process be termed a "pneumonid."

NOTE: The writers wish to acknowledge the assistance of Dr. W. W. Vaughan in the preparation of this report.

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Unusual Bone Lesions in an Infant, Probably Osteitis Tuberculosa Multiplex Cystoides¹

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THE FOLLOWING case, in a Chinese infant, is reported because of peculiar lesions of uncertain etiology involving many bones of both hands and forearms. It terminated in complete recovery without special treatment except for a liberal addition of oranges to the diet.

CASE REPORT

J. Y., Chinese male, was born at full term, the second child of a family of four. He was weaned at the age of four months and received thereafter a diet composed mainly of sterilized cow's milk and flour paste. Orange and tomato juice were added after the age of three months but were not available when the infant was nine months old. By the end of November 1939, at the age of eleven months, some swelling of the left middle finger, thought to be chilblains, was noticed. In addition, the child was likely to cry when handled, caught cold easily, was fretful, and slept poorly. At about the same time, there was an attack of fever accompanied by moderate swelling of the right submaxillary region, which lasted for two weeks. The left middle finger subsequently became more swollen and tender, but with no signs of infection, and a month later the right middle finger and the dorsum of the right hand also became swollen. The patient was then brought to the hospital for observation, at the age of fourteen months.

The infant was well developed and well nourished. The skin and mucous membranes were pale. The teeth and gums were in good condition. There was no jaundice, nor were petechiae or signs of bleeding anywhere discoverable. The heart and lungs appeared normal. The liver was not enlarged. The spleen was just palpable. There was firm swelling of the left second and third fingers, right middle finger, and dorsum of the right hand. There was no adenopathy. The red cell count was 3,900,000; white cell count 12,750 (polymorphonuclears 40 per cent, lymphocytes 50 per cent, monocytes 7 per cent, eosinophils 3 per cent). The blood platelet count was 130,000 per c.mm. Kahn and Ring tests were negative, and the stools were negative for blood and ova.

The first x-ray examination of the left hand (Fig. 1), on Feb. 16, 1940, two and a half months

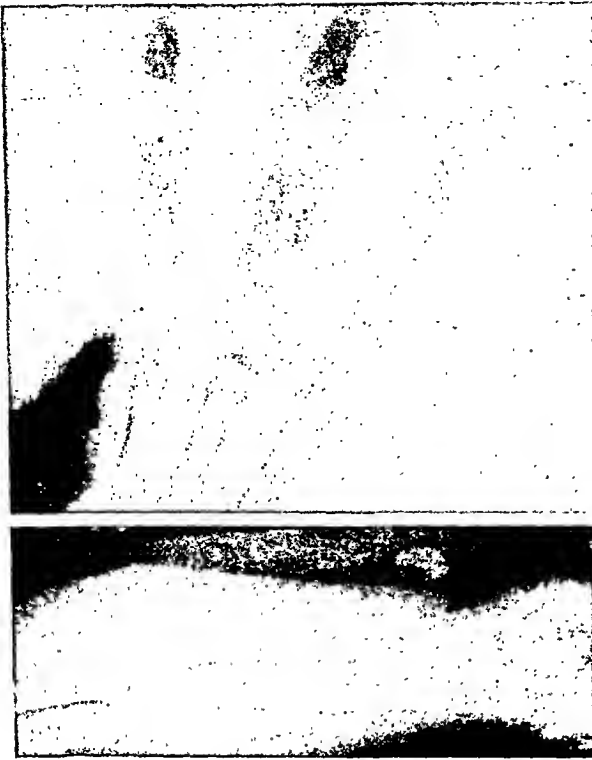
after the onset of symptoms, showed some widening of the shaft of the proximal phalanx of the third finger with a few tiny punched-out areas of rarefaction distally. The outline of the distal two-thirds of the same bone seemed slightly irregular. The middle phalanx of the same finger and the proximal phalanx of the fourth finger appeared slightly expanded. The x-ray diagnosis was indeterminate.



Fig. 1. Left hand: Moderate expansion with some cystic rarefaction of the proximal phalanx of the third finger; slight expansion of the middle phalanx of the third finger and of the proximal phalanx of the fourth finger.

Because of probable lack of vitamin C in the diet, and in view of some of the clinical signs and symptoms, the possibility of infantile scurvy was entertained. This suspicion was subsequently strengthened by a strongly positive capillary resistance test and the presence of many red blood cells in the urine. It was then decided to increase the vitamin C intake through the addition to the diet of three or four locally grown oranges daily. General improvement followed almost immediately and, although not dramatic, was steady and progressive. The tenderness soon disappeared, and the capillary resistance test became negative. The soft-tissue swelling and bone lesions of the affected parts, however, subsided slowly and did not resolve completely until over half a year later. As is to be noted below, there was pro-

¹ From the Departments of Radiology and of Medicine, United Hospital and College of Medicine, National Central University, Chengtu, China. Accepted for publication in February 1945.



Figs. 2 and 3. Irregular coarsely reticulated appearance of the proximal phalanx of the middle finger of the left hand. Note also slight erosion and scalloping of the distolateral portion of the same bone. The slight expansion of the other affected phalanges and the soft-tissue swelling of the third and fourth fingers remain about the same as before.

Irregular periosteal thickening of the greater part of the left ulna and of the middle of the radius.

gressive bone destruction during the early stages of x-ray observation; but this is not an unusual finding in many types of bone lesions exhibiting improvement clinically.

The second x-ray examination (Fig. 2), made on March 9, three weeks after the first examination, showed coarse trabeculae and small radiolucent areas, some 2 to 3 mm. in diameter, in the distal two-thirds of the proximal phalanx of the left third finger. There was slight destruction of the cortex of the same bone resulting in some scalloping. Moderate periosteal thickening of a somewhat uneven character was seen involving the greater part of the left ulna and the middle of the left radius (Fig. 3). The distal three-fourths of the right fourth and fifth metacarpals (Fig. 4) showed moderate enlargement with areas of sclerosis mingled with rarefaction, besides thickening of cortex and periosteum. An oval area, 1×2 mm., was present in the mid-portion of the right fifth metacarpal. The changes in these two bones differed from those of the proximal phalanx of the left third finger in that there was more sclerosis and no cortical erosion. The proximal phalanges of the right third and fourth fingers showed mild periosteal thickening. There was moderate periosteal thickening of an onion-peel type in the

distal half of the right ulna. The distal metaphyses of both radii and ulnae showed a band of sclerosis sharply defined from the shaft. Except for three or four dense transverse lines in the lower ends of both tibiae, the bones of the legs showed no significant change.

The third film of the left hand (Fig. 5), taken on April 17, two months after the first examination, showed the affected phalanges as expanded as before, but with slightly more calcification. The notching of the distolateral corner of the proximal phalanx of the third finger was slightly deeper than before. In the right hand, there was less expansion and also decreased sclerosis of the affected sections.



Fig. 4. Right forearm and hand. The fourth and fifth metacarpals show moderate enlargement with areas of sclerosis mixed with rarefaction. Note the oval area of rarefaction in the middle of the fifth metacarpal. There is increased density of the periphery and center of the capitate and hamate. The distal half of the ulna shows moderate periosteal thickening of an onion-peel character.

of the fourth and fifth metacarpals. Their trabeculae were moderately coarse, and the small radiolucent area in the middle of the fifth metacarpal was better defined, due to decreased sclerosis. The periosteal thickening of the left radius and ulna was less marked. The right radius also showed decreased periosteal thickening, with loss of some of the onion-peel appearance. The sclerosis in the distal metaphyses of the radii and ulnae was less pronounced than before. The capitate and hamate on both sides showed dense peripheries with a dense spot in their centers, changes which had been marked on the previous examination.

The fourth x-ray examination was done on July 18 (Fig. 6), five months after the first film. In the *left hand*, there was still some widening with mild sclerosis of the proximal phalanx of the third finger, but less marked than before; the defect in the distolateral portion had been filled up, thus indicating healing, although a rounded radiolucent area of about 3 mm. remained in the distal end of the bone, and there was still slight widening of the middle phalanx of the third finger and the proximal phalanx of the fourth finger. In the *right hand*, there continued to be slight expansion of the affected portions of the fourth and fifth metacarpals, with slight coarsening of trabeculae and mild thickening of the



Fig. 5. More destruction and scalloping of the proximal phalanx of the middle finger of the left hand.

cortex; the mild periosteal thickening of the proximal phalanges of the third and fourth fingers was less evident than before; and there was mild periosteal thickening of the lateral aspect of the first metacarpal. Except for slight cortical thickening of the mid-portions of the left radius and ulna, with some irregularity of their endosteal outlines, these bones appeared normal. The distal half of the right ulna was slightly expanded, but the onion-peel periosteal thickening had disappeared. The distal metaphyses of the radii and ulnae still showed some increased density. Of the capitates and hamates, only the right ones showed slightly dense peripheries.

The fifth x-ray examination was made on Sept. 27, seven months after the first examination. In the *left hand*, the proximal phalanx of the third finger was as wide as in the examination made over two months before, with moderately and irregularly thickened cortex, but the radiolucent area in the distal end of the bone was slightly smaller and its proximal margin was not well defined; the middle phalanx of the third finger and the proximal phalanx of the fourth finger were still slightly expanded, although their texture appeared fairly normal.

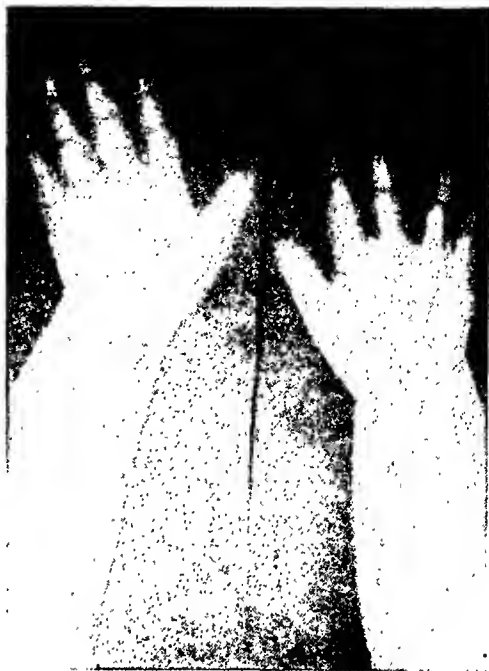


Fig. 6. Restoration of the cortical outline of the proximal phalanx of the left middle finger (note round radiolucent area distally). Almost normal appearance of the right fourth and fifth metacarpals. Resolution of the periosteal lesions of the involved bones of the forearms. Persistence of increased density of the distal ends of the radii and ulnae.

In the *right hand*, the fourth and fifth metacarpals were still slightly expanded, but with fairly normal texture, and the thickening of the periosteum of the first metacarpal had disappeared. The shafts of the left radius and ulna appeared normal. There was only mild widening of the distal half of the right ulna. Mild sclerosis could still be seen in the distal metaphyses of the radii and ulnae. The right capitate and hamate continued to show slightly dense peripheries.

A bilateral cervical adenitis developed in March 1941, the following year. Soon afterward, one of the nodes on the right side pointed and had to be incised, following which the wound refused to heal. The patient was then taken to a neighboring province. There, the suppurating nodes in the right side of the neck were excised, and closure of the wound followed in the early part of 1942. A tuberculin test was performed in February 1942 (von Pirquet method), but the result was inconclusive. A second test performed the following month (Mantoux test, 0.1 mg. of 1/1000 old tuberculin) was strongly positive. The child's general health was satisfactory all along. He was brought back to Chengtu in the summer of 1943.

A check-up x-ray examination in January 1944 showed normal development and architecture of the bones of both hands and forearms, and no significant change in either lung. Some swelling with slight

tenderness developed over the dorsum of the left foot in February 1945. This disappeared in a week's time, and x-ray examination revealed no significant bony changes; the lungs also appeared clear.

DISCUSSION

The interest in the above case lies in the diagnosis of the unusual bone lesions. This, unfortunately, could be only speculative, as no pathologic and biochemical observations were made, except for the development of tuberculous cervical adenopathy and a positive tuberculin test over a year later, which might or might not be related to the bone lesions. To recapitulate, the osseous lesions were confined for the most part to the short bones of the hands and showed a combination of the following features: widening of bone, sclerosis, rarefaction, tiny punched-out areas of destruction, cortical erosion, and periosteal thickening. In addition, there was periosteal thickening of the radius and ulna, in one locality of an onion-peel character, with some sclerosis of the distal metaphyses of the same bones. Following the addition of oranges to the diet, there was immediate and steady improvement of the general condition. The bone lesions, however, at first showed further progression, followed some weeks later by healing, which was progressive and almost complete at the end of seven months. No trace of any lesion could be found in a check-up examination four years later.

The x-ray appearances do not seem to fit in with any of the usual disease entities. Syphilis could be safely excluded because of the negative serology and recovery without the use of antisyphilitic treatment. Boeck's sarcoid should show only multiple small cystic-like areas in the bones, without any cortical or periosteal reactive changes, and is usually associated with lesions in other organs. The ordinary form of tuberculosis should be progressive, ending in sinus formation and other deformities. There may, however, be a possible resemblance of our case to the so-called osteitis tuberculosa multi-

plex cystoides first described by Jüngling in 1920, and subsequently by a few other investigators, including Law and Perham (1) and Connolly (2), since some cases of osteitis tuberculosa multiplex cystoides have been reported to proceed to complete recovery. Some other observers, as News (3), regard Boeck's sarcoid and osteitis tuberculosa multiplex cystoides as synonymous. Aside from multiple cyst-like areas, the reported cases of osteitis tuberculosa multiplex cystoides usually showed no other bony changes. In our case, other types of bone lesions dominated the picture, and only a somewhat cyst-like change occurred in two areas. Law and Perham, discussing the differential diagnosis of osteitis tuberculosa multiplex cystoides, named the following conditions: syphilis, chronic pyogenic osteomyelitis, hyperparathyroidism, xanthoma multiple myeloma, coccidioidal granuloma, enchondrosis, leprosy, and metastatic cancer, none of which fits in with our case. Finally, especially in view of the favorable therapeutic response, infantile scurvy has to be considered, although we must admit that the bone changes are not characteristic of scurvy. The periosteal thickening does not in any way resemble that of calcified subperiosteal hematoma; widening of bone and sclerosis have not been described in scurvy, and punched-out areas of rarefaction are not listed in the standard picture, except for the description of Holmes and Ruggles (4), which seems to be the nearest approach to the findings in our case. They say: "Very frequently irregular areas of rarefaction several millimeters in diameter appear in the shaft, at the junction of the cortex and epiphyseal zone." As mentioned before, the strongest point in favor of infantile scurvy is the favorable response to therapy, if the addition of oranges to the diet can be considered as such. In regard to the vitamin C content of Szechwan oranges, the investigations of Chang and Collier (5) and of Hou (6) indicate that it is as high as that of those grown elsewhere, for example, in California.

SUMMARY

Unusual lesions in the bones of the hands and forearms of a Chinese male infant are reported. The changes consisted of widening of bone, sclerosis, rarefaction, punched-out areas of destruction, and periosteal thickening. Following the addition of oranges to the diet, the bone lesions gradually disappeared, leaving only residual changes seven months later, and no trace on subsequent examination four years afterward. The patient had tuberculous cervical adenopathy the year following the onset of the bone lesions. The peculiar bone changes did not fit in properly with any disease entity, and in the absence of biochemical and pathological studies, no definite diagnosis could be made. The nearest approach seems to be osteitis tuberculosa multiplex cystoides with somewhat atypical roentgenologic changes.

However, when the favorable therapeutic response is taken into account, infantile scurvy with atypical bone changes may be remotely considered.

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Congenital Absence of the Odontoid Process¹

Report of a Case

MAJOR JOS. McK. IVIE, M.C., A.U.S.

COMPLETE absence of the odontoid process of the second cervical vertebra is not a common congenital anomaly.

Roberts in 1933 reported the case of a twenty-year-old man who entered the hospital complaining of severe sudden pain in the neck following exercise in the gymnasium. Roentgen examination showed absence of the odontoid process and a posterior dislocation of the right anterior facet of the atlas on the axis. The patient refused operation and was treated conservatively.

In 1942 Weiler reported the case of a fourteen-year-old girl who entered the hospital complaining of pain and stiffness of the neck and inability to straighten the head, which was turned to the left. She had fallen while playing, striking her head and neck forcibly on the ground. Roentgen examination revealed lateral and posterior displacement of the atlas and absence of the odontoid. Reduction and fusion of the cervical vertebrae were done. In a footnote Weiler stated he had had one other case.

REPORT OF CASE

A white soldier, aged 23, was admitted to the hospital on March 16, 1944. He had injured his neck on March 10, 1944, while wrestling. He suffered immediate weakness of the extremities but no loss of sensation. After lying quietly for half an hour, he gradually regained strength in the extremities but noticed a tingling sensation in the fingers and toes, more severe on the left side than the right. He walked into the hospital complaining of a return of the former weakness and tingling of the fingers and toes.

The patient's past history was negative. He had never had any experience similar to his present one. Physical and neurological examinations were essentially negative.

Roentgen examination of the cervical spine showed a partial dislocation of the atlas on the axis, anteriorly (Fig. 2) and laterally (Fig. 3). The



Fig. 1. Complete absence of the odontoid process. Note the sulcus on either side of the space normally occupied by the odontoid.

odontoid process of the second cervical vertebra was absent (Fig. 1). There was a small sulcus on either side of the space which the odontoid normally occupies medial to the articulating facets. Lamina graphic examination failed to show any signs of old or new fractures.

The dislocation was reduced by traction of the head by means of Crutchfield tongs applied to the skull. The patient was comfortable in traction and symptoms of tingling of the fingers and toes and weakness of the extremities disappeared. Several roentgen examinations while traction was being applied showed varying degrees of dislocation of the atlas on the axis, depending on the positioning of the head. After two weeks in traction a hyperextension cast was applied and the patient was allowed to walk around. Three weeks later the cast was broken and removed for neck massage. On one occasion the tingling of the left hand returned, but this soon subsided and the patient had no further trouble. On June 2, 1944, he was returned to military duty below the general service level. He was instructed to avoid physical exertion and was assigned in a fixed installation.

¹ Accepted for publication in February 1945.

COMMENT

This case is interesting in that there was evidence of spinal cord injury following trauma to the neck. There is always a



Fig. 2. Anterior dislocation of the first cervical vertebra on the second. Note the smooth surface of the second cervical vertebra and absence of the odontoid.

possibility of a recurrence and perhaps serious cord damage. If fusion of the cervical spine is not done, the patient



Fig. 3. Dislocation of the first cervical vertebra to the right. On other examinations there was dislocation to the left, depending on the position of the head.

should be carefully instructed as to the potential danger of his condition.

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Congenital Absence of the Septum Pellucidum Associated with Internal Hydrocephalus

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THE PNEUMOENCEPHALOGRAPHIC diagnosis of congenital absence of the septum pellucidum is exceedingly rare. For that reason and because of the associated enlargement of the ventricular system, without any other apparent brain lesion, the present case is regarded as worthy of publication.

The first report of congenital absence of the septum pellucidum was made by Tenchini (1) in 1880, in a boy of two and a half years who was normal mentally. Hochstetter (2) added three cases. In two of them the anomaly was observed in well formed brains of fetuses 118 and 168 mm. crown-rump length, in one instance with internal hydrocephalus. The third case was observed in the dissecting room and was published in 1925. Hahn and Kuhlenbeck (3) also encountered this abnormality in the dissecting room, in 1930. In 1938 Dolgopol (4) described a case discovered at necropsy in a woman aged 60, with moderate hydrocephalus. He believed that the case was not one of aplasia but of secondary disappearance of the septum pellucidum.

In 1933 Forster (quoted by Sfintesco and Mihailescu, 7) observed absence of the septum pellucidum encephalographically, but he ignored the congenital etiology of the condition, believing that it was the result of trauma to the skull. Dyke and Davidoff (5) are rightfully accredited with having made the first encephalographic diagnosis of congenital absence of the septum pellucidum, in 1935. In the same year Berkwitz and Rigler (6) reported a case of tuberous sclerosis in a two-year-old girl, diagnosed by cerebral pneumography. The encephalograms in this case revealed a moderate general enlargement of the ventricles and complete absence of

the septum pellucidum. The authors not consider the hydrocephalus of sufficient degree to cause disappearance of the septum pellucidum and concluded that it represented "an accompanying congenital anomaly of a rather unusual type."

In 1937 and 1938 Sfintesco and Mihailescu (7) described, consecutively, two cases of this abnormality discovered by ventriculography. The last case published to date is that of Reeves (8) who, in 1941, diagnosed encephalographically absence of the septum pellucidum associated with congenital amaurosis.

CASE REPORT

R. G., a Negro boy, aged 13 years, entered the hospital on Aug. 23, 1944, complaining of headaches and vomiting.

The family history was irrelevant. Five years earlier the patient had fallen, sustaining a slight laceration over the frontal area. It was about a year later that the present complaints developed. The headaches were of moderate intensity, periodic in character, occurring about once a week with a sudden attack of vomiting. They ceased after a few minutes and were followed by a sensation of euphoria.

The patient was a tall, well developed boy, mentally alert, with normal coordination and normal reflexes. He presented a slight left internal strabismus. The fundoscopic examination was negative. The blood pressure was 100 mm. mercury systolic and 80 diastolic. Routine laboratory data, including total protein and Kahn tests, were normal.

A regular roentgenogram of the skull showed no findings of interest, except the wormian bone, seen also in the postero-anterior encephalogram (Fig. 3). Pneumoencephalograms disclosed slight to moderate dilatation of the ventricular system, with confluence of gas in the mid-line in the anteroposterior view (Fig. 1). The postero-anterior view showed confluence of the lateral ventricles anteriorly and their normal separation posteriorly (Fig. 3). The lateral views (Fig. 2) demonstrated three shadows of different densities, the darkest representing the confluence of air in the two lateral ventricles.

¹ From the Department of Radiology, Provident Hospital, Chicago, Ill. Accepted for publication in March, 1945.



Fig. 1. Agnesis of septum pellucidum: antero-posterior encephalogram showing confluence of air (arrow) of the lateral ventricles.

Clinical Diagnosis: Migraine of undetermined etiology.

Encephalographic Diagnosis: Congenital absence of the septum pellucidum with internal hydrocephalus.

DISCUSSION

It is not deemed necessary to discuss the symptomatology in such cases as the one recorded at any length. The want of clinical findings, as well as the paucity of cases published, makes any conjecture unwarrantable. Only by correlating experiences of different observers is there hope of establishing definite clinical criteria.

In the case now under discussion there occurred periodic headaches and vomiting not related to the absence of the septum pellucidum. The history of a fall five years earlier is not significant. It was not followed by unconsciousness, and there was no fracture of the skull apparent on retrospective diagnosis. The patient has been symptom-free since October 8, 1944.



Fig. 2. Agnesis of septum pellucidum: lateral encephalogram. The arrows indicate, from left to right (A) one gas-filled ventricle, (B) superimposed lateral ventricles, and (C) comma-shaped image due to absence of the septum pellucidum.

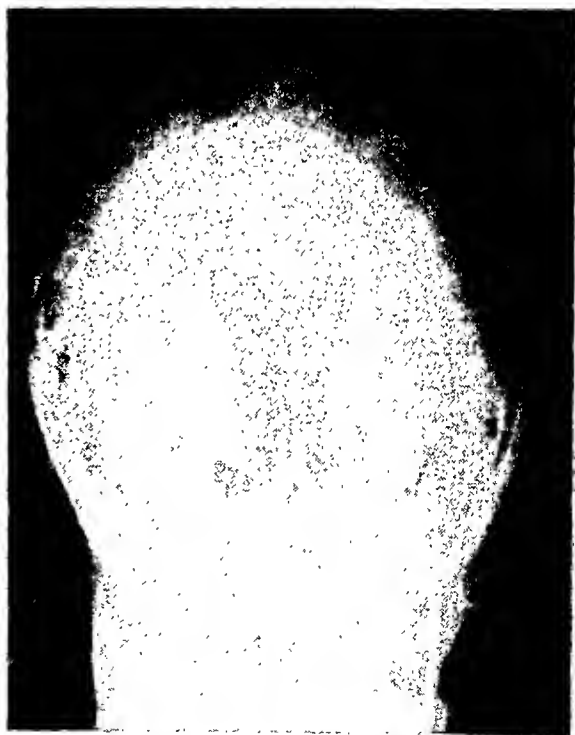


Fig. 3. Agnesis of septum pellucidum: postero-anterior view showing confluence of the lateral ventricles anteriorly and normal separation posteriorly.

The hydrocephalus is evidenced by the rounding of the lateral ventricles at their upper and outer angles and the circular form of the third ventricle, this latter structure being usually lenticular in shape.

Dilatation of the ventricular system has been observed by different writers in connection with the congenital absence of the septum pellucidum. It is not likely, however, that hydrocephalus could play a role in the genesis of this condition in prenatal life, inasmuch as the abnormality may exist with normal ventricles. The contribution of hydrocephalus to complete secondary disappearance of the structure by a process of resorption or by atrophy of its walls hardly seems plausible. It is known that marked dilatation of the lateral ventricles may contribute to fenestration of the septum pellucidum in postnatal life; however, no cases have been recorded in which a defect of this structure secondary to hydrocephalus might be so similar as to confuse the diagnosis.

The important points in making the diagnosis are: confluence of gas in the midline, giving a shadow equal in density to that of the lateral ventricles, absence of the thin linear shadow of the septum pellucidum which usually separates the lateral ventricles, and its replacement by air (Fig. 1). The postero-anterior view (Fig. 3) shows the confluence of the lateral ventricles anteriorly and their normal separation posteriorly. The lateral encephalogram demonstrates three different shadows (Fig. 2): the light shadow representing the one air-filled ventricle, the darker being that of the superimposed shadows of the lateral ventricles; the darkest, comma-shaped in appearance, showing the confluent air in the lateral ventricles, due to the agenesis of the septum pellucidum. Since a persistent *cavum septi pellucidi et vergae* may produce the same encephalographic findings in the lateral view, this position alone is not diagnostic.

Dyke, Davidoff, and Reeves observed

in their cases a nipple-like projection from the ventral aspect of the lateral ventricles at the region of the dorsal surface of the anterior pillar of the fornix. This interesting finding is not seen in the anteroposterior view in the present case.

SUMMARY

1. A case of congenital absence of the septum pellucidum associated with internal hydrocephalus is reported.
2. This case is the seventh known to be diagnosed encephalographically.
3. There are no known clinical or neurological symptoms of this abnormality.
4. The anteroposterior and postero-anterior views are diagnostic.

NOTE: I wish to express my sincere thanks to Miss Irene Hill and Miss Avis Gregersen for their valuable assistance.

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March Fracture of the Articular Surface of the Tibia and Its Relation to Osteoarthropathy¹

LT. COL. JOSEPH LEVITIN, M.C., A.U.S.

THE AVAILABILITY of x-ray examination to the large number of individuals in the Armed Services has brought to light many minimal injuries which tend to be ignored or overlooked in a comparable civilian population, while the rigors of training have increased the incidence of such injuries. There have been many reports on march fractures of the metatarsals observed during training periods and following marches. To the metatarsal fracture have been added march fracture of the femoral neck (1), march fracture of the femur (2), of the tibia (3), of the fibula (4), and even march fracture of the pelvis (5). These fractures have been called, also, insufficiency fractures and fatigue fractures. They are not new. The march fracture of the metatarsal has long been known. It was noted among recruits in the French army, where it was called *pes marches*. It was frequent, also, among the German troops, especially after practising the "goose-step" of the old Imperial Army, being known as *Füssgeschwulst*.

Insufficiency fractures of the tibia were noted in the Swedish army by Aleman (6) in 1929, about 100 cases being reported yearly in recruits. Callus formation was noted about the tibia, but the fracture line was never demonstrable. The condition was called *periostitis tibiae ab exercito*. Glogau (7) reported a "recruits' disease" in the German army, having observed 30 cases of indirect fractures of the shaft of the fibula in soldiers, attributed to muscle pull. All these fractures occur in civilian life, but the injury is usually too trivial to bring the patient for x-ray examination.

To the accumulating literature on march fractures, the author wishes to add another type of injury. This is a linear fracture of the articular surface of the tibial plateau. As with march fractures elsewhere,

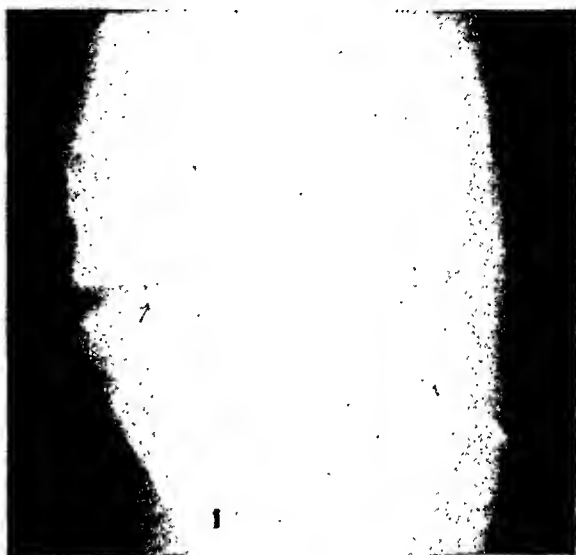
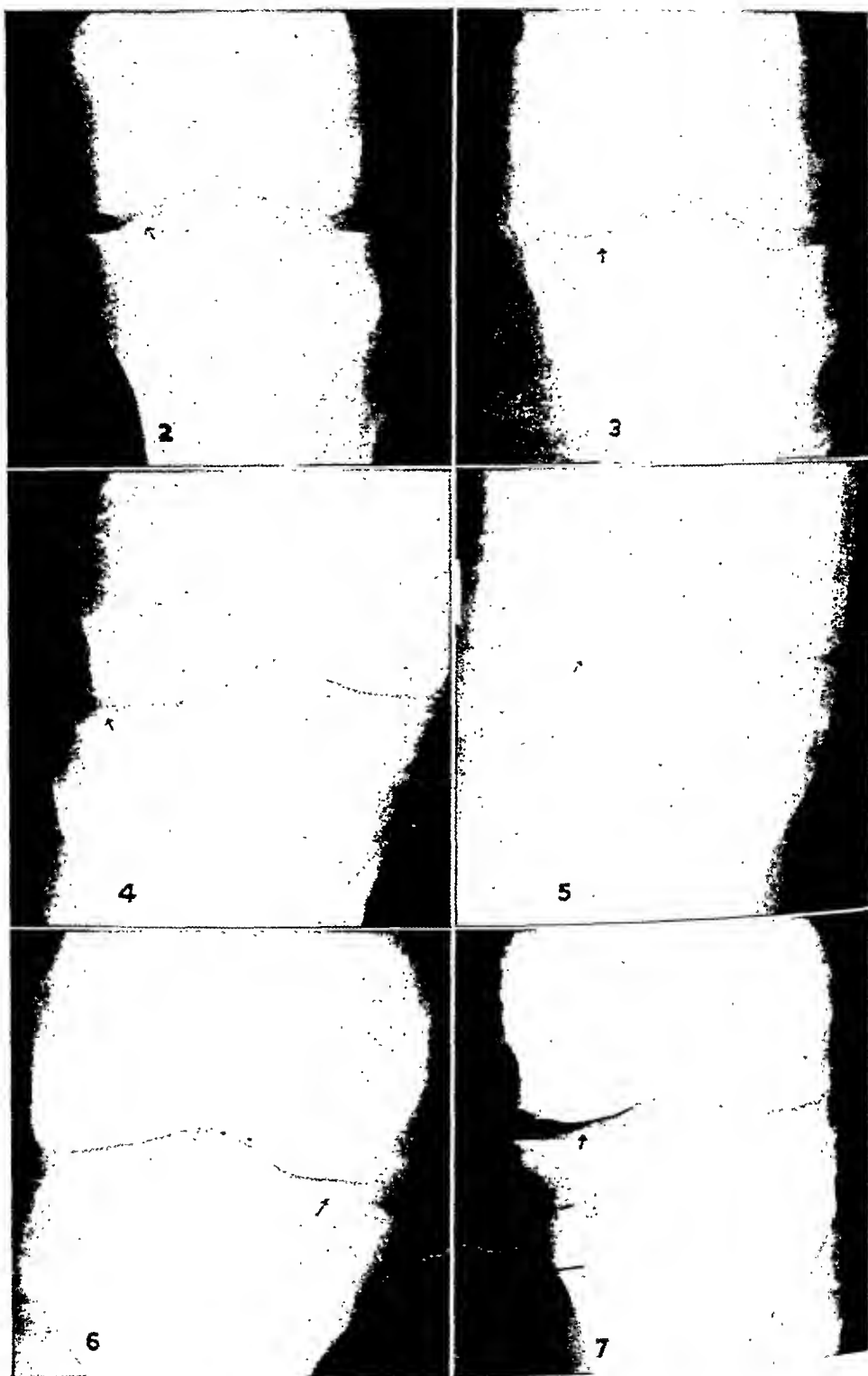


Fig. 1. Transverse fracture of articular tibial condyle, indicated by arrow.

there is no history of definite trauma. Pain in the knee is often first noted after a long hike. More than likely the soldier was carrying a full pack, which adds to the weight supported by the tibial plateau. It is significant that but 2 cases occurred in officers. Usually the patient reports to the dispensary some days or weeks later, with pain in the knee aggravated by walking but with no limitation in motion. The usual clinical diagnosis is synovitis, arthritis, or derangement of the knee joint. Physical examination in cases of long standing may show some limitation of motion; otherwise the findings are normal. X-ray examination demonstrates a linear transverse fracture line on the tibial plateau. There is no predilection as to site, although the internal condyle is more frequently involved than the external.

A review of all the roentgenograms of knees taken at this hospital in a period of twenty-four months showed 64 cases of march fracture of this type out of a total 1,900 knees. All knee examinations were

¹ Accepted for publication in March 1945.



Figs. 2 and 3. Transverse fractures of articular tibial condyle, indicated by arrows.
 Figs. 4 and 5. Old transverse fractures of articular surface of tibial condyle, indicated by arrows, associated with vertical fracture through the condyle.
 Fig. 6. Old transverse fracture of articular margin of external tibial condyle, associated with marginal spur.
 Fig. 7. Old transverse fracture of articular margin of internal tibial condyle, associated with osteoarthritis.

made bilaterally. In every instance the site of pain coincided with the site of fracture. No fracture was found in a knee unassociated with pain. In 46 cases the fracture was on the internal condyle, in 8 on the external, a ratio of 2.6 to 1. The incidence in the right knee was slightly greater than in the left. This fracture line has also been found associated with vertically displaced fractures of the condyle. Six cases were bilateral and one had a fracture line through both condyles.

These fractures differ in one respect from other types of march fracture, *i.e.*, in the production of callus. No bony callus develops to obliterate the fracture line. The longest observation period was six months, without change in the appearance of the fracture line. Further evidence of lack of callus formation was afforded by many cases with a persistent fracture line in which the complaint of intermittent knee pain antedated by many years entry into the army. In addition, these old cases had osteoarthropathic changes as evidenced by marginal spurs, eburnations, areas of rarefaction, and some fragmentation.

These injuries do occur in civilian life but, as suggested above, are of such trivial nature that the patient is not submitted to x-ray examination until later, when osteoarthritic changes have developed. In two instances civilian employees were examined by x-ray for minor knee complaints, and the fracture line was found. Such a fracture is probably the underlying cause of many of the unilateral single-joint osteoarthropathies found in middle-age. Whether or not osteoarthropathy invariably follows the injury is difficult to tell at this time. A follow-up of these cases years later may settle that point.

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Since this paper was submitted, the films were shown to Dr. Arthur L. Fisher of San Francisco, whose comments follow:

"The interpretation of this lesion may be subject to some difference of opinion. It is possible that it does not represent a fracture, but rather a subcortical demineralization of the bone which constitutes an early stage in the development of

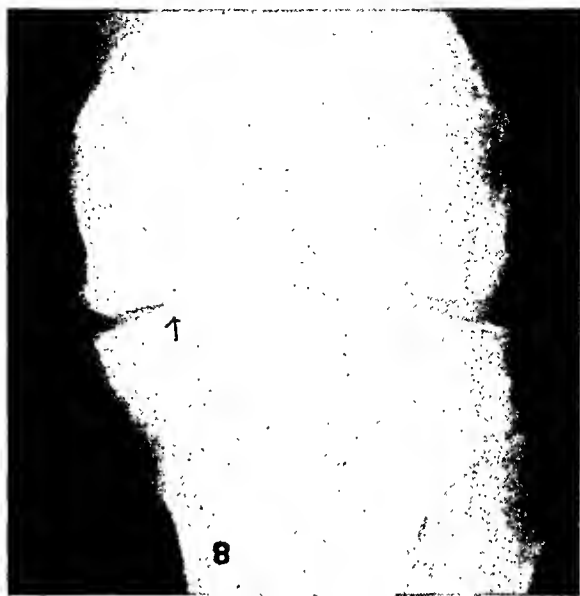


Fig. 8. Old transverse fracture of articular margin of internal tibial condyle associated with marked osteoarthropathy.

arthritis, the demineralization being due perhaps to an inflammatory reaction in the small marrow spaces in this location.

"In two of the films it appears that the process has penetrated the cortex in one place (see particularly Figure 1). In some films taken in civil practice similar appearances have usually been considered to indicate early arthritis.

"The interesting point in the present series is that these lesions occurred in young, apparently healthy men who had made long marches, carrying heavy packs. It is possible that the lesions existed before they went into training and were discovered only after the extra exertion called attention to the condition of the knee and led to x-ray examination."

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Fatigue Fracture of the Metatarsal

Report of a Case¹

MAJOR WILLIAM E. ALLEN, Jr., M.C., A.U.S.

THE INCIDENCE of march and/or fatigue fracture at this Army post, where thousands of troops have been in training over rocky terrain for the past three years, has been very low as compared with the incidence at other posts. The enlisted personnel were all colored. With the ex-

quate rest periods had not been seen until the present case.

Constant foot strain, such as would be sustained in hiking, marching, or standing for long periods of time is the usual history in these cases according to Krause (3), Hullinger and Tyler (2) and Tyler and

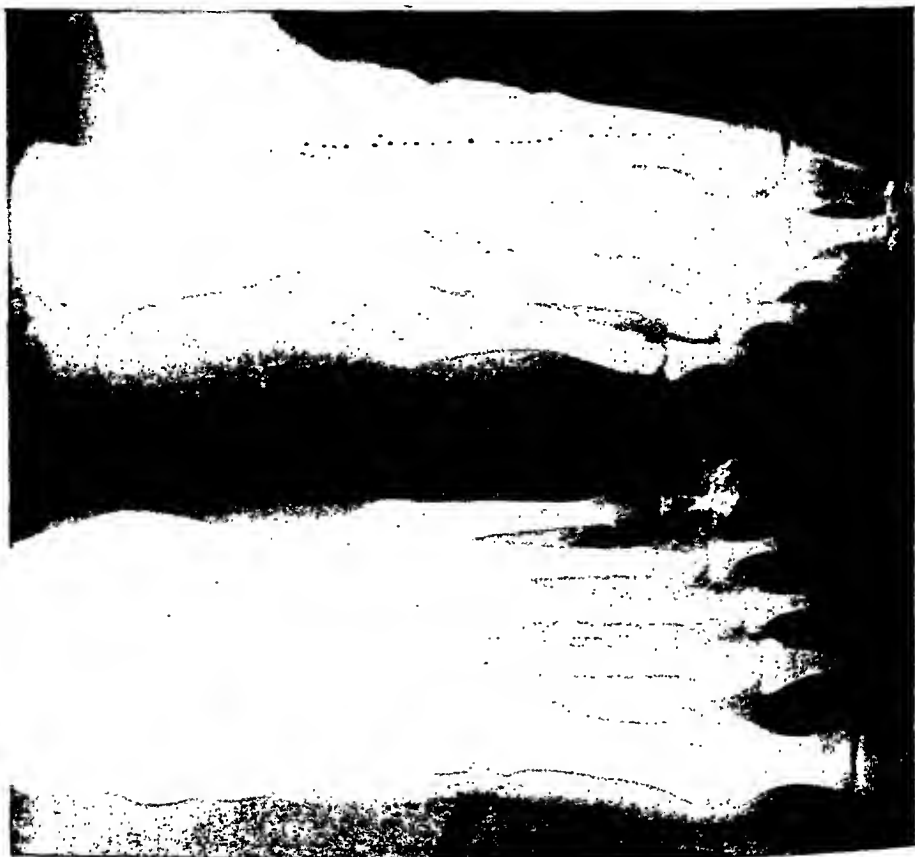


Fig. 1. Nick involving dorsal aspect of the cortex of the right third metatarsal in the middle third.

ception of the case to be reported, the few examples seen were invariably associated with long marches through the mountains. All involved the metatarsals. There was no instance of involvement of any other bone. Fatigue fracture (1) or spontaneous fracture occurring in normal bone subjected to prolonged stress without ade-

Hileman (4) emphasize the etiologic significance of fatigue, with loss of muscular tone and the throwing of the entire weight of the body on the metatarsals. The fractures are more apt to occur after prolonged walking or standing on hard surfaces, due to the repeated minor trauma and associated muscle fatigue. The fact that this type of fracture does occur in soldiers whose duties do not require strenuous

¹ Accepted for publication in February 1945.

marching or hiking, but who are subjected to walking or standing for prolonged periods, should be considered in every case of painful foot coming for treatment.

REPORT OF A CASE

A colored soldier, aged 23, awoke on the morning of Aug. 7, 1944, and found his right foot swollen and slightly painful. He was one of the company cooks and, although he had been working the previous day, his duties had not been unduly arduous. He had been on his feet during his entire tour but had noticed no pain or disability in the foot. He continued on duty for three days, at the end of which

third (Fig. 1). This shadow, however, was only suggestive of a nick involving the cortex and was not considered sufficient basis for a diagnosis of fracture. There was no evidence of bone disease. The examination was reported as negative, with the request that the patient be returned for re-examination in ten days if his condition did not improve. He received treatment in the physiotherapy department of the Orthopedic Clinic as an outpatient until Aug. 12, when he was admitted to the hospital.

At the time of his admission to the hospital, the patient had had a period of military service of twenty-three months, the first thirteen weeks having been spent in basic training and the remainder as company cook. He had been a farmer prior to in-

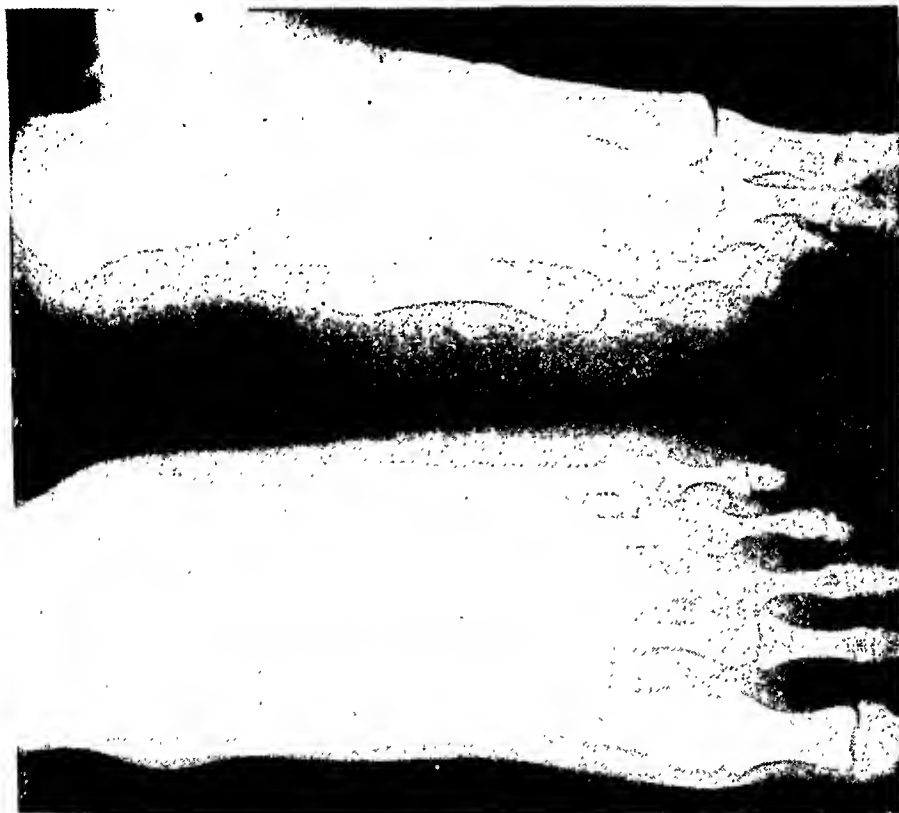


Fig. 2. Roentgenogram made three weeks after Figure 1, showing excessive callus along the shaft of the right third metatarsal.

the foot had become so painful and swollen he was forced to report to his regimental dispensary for treatment. The patient vigorously denied any history of trauma to the foot, on both direct and indirect questioning. He also denied lifting any heavy objects and had done no drilling or participated in any long marches for the past eight months. The dispensary surgeon sent him to the hospital for an x-ray examination of the right foot, with a clinical diagnosis of possible hypertrophic arthritis. The examination revealed a faint indefinite linear shadow of decreased density involving the latero-dorsal aspect of the third metatarsal in the middle

duction and had never experienced any pain or disability in either foot. He denied the use of tobacco, alcohol, or drugs, but admitted the usual diseases of childhood and "rheumatism" in the right leg in 1930. The venereal disease history was negative.

The patient's height was 5 ft. 8 in., his weight 190 lb. The findings on physical examination were negative except for the right foot, which was slightly edematous, especially on the dorsum, and mildly painful in the mid-metatarsal region, both to palpation and upon walking. Laboratory findings were as follows: erythrocyte count 4,500,000; leukocyte count 9,500 (polymorphonuclear cells 54 per cent;

lymphocytes 46 per cent); sedimentation rate normal; urinalysis negative; Kahn reaction negative; blood pressure 130/85.

The patient continued to receive physiotherapy until Sept. 5, 1944, when, since his condition showed little or no improvement, he was returned to the x-ray department for re-examination. X-ray examination of the foot at this time revealed a large amount of callus surrounding the shaft of the third metatarsal in the middle third, at the site of the previously seen nick (Fig. 2). A very faint fracture line was now demonstrable. A light plaster cast was applied and recovery was uneventful.

SUMMARY

1. A case of fatigue fracture of the metatarsal, apparently the result of prolonged standing and walking on a hard surface, is reported.

2. The fact that fatigue and/or march fractures are not always associated with prolonged marching or hiking is emphasized.

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Cancer of the Skin: A Statistical Report¹

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THIS IS A MORE or less preliminary report on those epitheliomas of the skin seen by me between June 1, 1921, and January 1, 1944. It is limited to epitheliomas having their origin in the skin; melanomas, benign and malignant, cancers arising in the mucous membranes, such as true lip cancers, and cancers metastasizing to the skin from other organs or tissues are not included. The biopsy reports show that the lesions were basal-cell, squamous-cell, and mixed basal- and squamous-cell cancers, cancers reported as basal- or squamous-cell but not possible to differentiate, papillary and transitional-cell cancers. The pathologists who made the reports in every instance placed the origin in skin structures.

The number of lesions seen and treated before 1926 is relatively small, and most of the recurrences (15 of 25) are among those treated before that year. The dosage used at that time would today be considered inadequate.

Röntgen rays were used in 1,205 of the cases treated, or 89.5 per cent; 4.5 per cent were treated by radium and 6 per cent by surgery, including excision, coagulation, and desiccation. The end-results in the surgically treated cases are not included in this report. The reasons for choosing a surgical method were varied, but for the most part such a choice was based on ease of excision by knife or cautery and the possibility, in some instances, of less scarring than after irradiation. The reverse choice—irradiation rather than surgery—was usually made for the same reasons: less scarring and less trouble for the patient. My experience leads me to believe that excision should be the method of choice for the larger lesions about the

TABLE I: DISTRIBUTION OF LESIONS IN WHICH BIOPSY WAS DONE

Region	Basal-cell	Squamous-cell	Mixed Basal- and Squamous	Others
	%	%	%	%
Scalp	57	43	0	0
Face	48	46	5	0
Nose	56	40	3	1
Eyelids	55	27	9	9
Skin of upper lip	57	29	7	7 (1 papillary)
Skin of lower lip	0	100	0	0 (only 3 biopsied)
Ears	14	80	0	6 (1 transitional-cell)
Neck	37	57	3	3
Trunk	68	23	9	0
Hand and fingers	17	78	0	4
Extremities (including hands)	23	74	0	4

hands, and especially about the wrists. The proximity of bone and connective tissue here renders a late radiation necrosis more likely, and excision in this area is not too difficult. The danger of late radiation necrosis, I believe, applies only to the usual type of low-voltage therapy; I am now using high-voltage radiation with copper filter for such lesions where operation is not advisable. It is, however, too early to report on the result.

Until I was able to check a substantial number of lesions by biopsy, I had a rather strong impression that one with sufficient experience could make a fairly accurate guess as to whether a lesion were basal-cell or squamous-cell, an impression also conveyed by the textbooks. A large number of biopsies, combined with color films, both stills and movies, soon changed my mind. I now feel strongly that these lesions, for statistical purposes—i.e., for assessing the effect of treatment—should be listed simply

¹ This study was financed in part by the E. Palmer Gavit Memorial Fund. The paper was read at the Joint Meeting of the American Roentgen Ray Society and the Radiological Society of North America, Chicago, Ill., Sept. 24-29, 1944.

TABLE II: LESIONS TREATED AND TRACED, BY YEARS

2 years +.....	443
3 years +.....	342
4 years +.....	260
5 years +.....	201
8 years +.....	93
10 years +.....	66
12 years +.....	40
14 years +.....	18
16 years +.....	8
17 years +.....	2
18 years.....	2

as epitheliomas (or skin cancer, basal- or squamous-cell not determined) instead of classified as basal-cell and squamous-cell solely on the clinical evidence. So far as the use of radiation is concerned, such classification makes very little difference, as the dosage and result of treatment should be the same. I heartily agree with MacKee and Cipollaro that "it is impossible to distinguish with certainty between basal-cell and baso-squamous-cell growths, and not infrequently both of these types are mistaken for the less malignant grades of squamous-cell epitheliomas" (Cutaneous Cancer and Pre-Cancer, published by American Journal of Cancer, 1937).

Lesions so advanced as to be suitable only for palliative treatment are not included in this series, although one patient was carried for six years, eventually to die from a brain abscess following extension into the cranial cavity. Patients with recurrences were all retreated and remained well as long as followed: 12 less than one year, 1 for one year, 5 for two years, 1 for three and a half years, 1 for four years, 1 for five years, 1 for six years, 1 for nine years, 1 for eleven years, 1 for fifteen years, these periods all dating from the last treatment, *i.e.*, the treatment for recurrence. We have thus a total of 25 recurrences all retreated, 12 followed two years or more and 6 four years or more. One patient, followed for four years, was killed in an accident, and there was no recurrence up to that time. Two had had repeated treatments elsewhere. One of these was treated four and again three years earlier, with a third recurrence seven months after my first treatment. There was no further recurrence in six years. The other had a squamous-cell

lesion of the skin of the lower lip. It had been treated by x-ray in 1904 and again after eighteen months; by excision in 1913, and by plaster in 1917. A recurrence, in 1918, grew very little until 1926, when I first saw the patient. He had had anti-syphilitic treatment from 1913 to 1922. I treated him with radium for repeated recurrences to 1932, when the last treatment was given. There had been no further recurrence when he was last seen in November 1943, after eleven years. A submental node was treated with x-rays in 1930 and 1932 and disappeared. So far, all recurrences that have been followed two years or more have remained cured. As this report covers only the 443 lesions treated by radiation and followed two years or more, only 12 of these 25 recurrent tumors are included. Of the series, 342 have been followed three years or more, 260 four years, and 201 five to eighteen years. These include the retreated recurrences. Sixty-six patients have been followed more than ten years, 8 more than sixteen years. All of those followed have remained well. This also applies to the few treated by surgery. No attempt is made to estimate the possible results in the 88 lesions followed for one year or less. Every effort is being made to trace as many of these as possible and it is hoped that a more complete report may be made in the future.

Late radiation necrosis occurred in 16 instances, 3.6 per cent of the 443 traced two years or more. This healed eventually in each instance, without surgical intervention.

SUMMARY

Between June 1, 1921, and Jan. 1, 1944, 1,347 cancers of the skin were seen, of which 1,269 were treated by radiation and 78 by surgery. Of those treated by radiation, 443 were traced from two to eighteen years. There were 25 recurrences, all of which were retreated. Of the 12 retreated lesions traced for two years or more, all remained cured. Biopsy was done in 38 lesions, and the results indicate that it is

usually impossible to differentiate clinically between basal-cell, squamous-cell, and other forms of skin cancer, and that the type of cell makes little, if any, difference in the results of treatment.

CONCLUSIONS

In reporting results of the treatment of non-melanotic cancer of the skin, all such lesions should be designated as epitheliomas (or cancers, type not determined) unless biopsy has been done.

These cancers, even though moderately advanced, are highly curable by adequate radiation or adequate surgery.

520 Chapala
Santa Barbara, Calif.

DISCUSSION

Rollin H. Stevens, M.D. (Detroit, Mich.): I have little to add to Dr. Ullmann's paper. His statistics are encouraging to both physician and patient. Perhaps we ought to devote a little more attention to details in getting up these statistical papers—as to dosage and some of the conditions that vary from patient to patient—but it is certainly helpful to have the results of one's work confirmed.

Dr. Ullmann (*closing*): I purposely did not discuss dosage because, in a strictly statistical report such as this, I felt it was unnecessary. There is little or no difference in the almost universally accepted methods, of which one of the earliest exponents was Dr. James M. Martin, of Dallas, Texas. One point, however, I wish to bring out. My machine is calibrated with a Victoreen thimble chamber set at the same distance from the end of the metal cone as is the skin when the treatment is given. There is secondary radiation from the cone, so that, while the dose is registered in air, the total dose is that coming from the x-ray tube plus the secondary rays spraying down from the cone. Therefore, the output through the cone, when it approaches the lesion, is greater than the output measured strictly

in air without a cone. The lesion itself is shielded by lead foil to the distance desired for that particular lesion.

For ordinary circular or oval lesions up to 1 cm. in diameter, or slightly larger, the dose is about 5,000 r. I say "about," because sometimes it is 4,995 or so, depending on the calibration at that time. The dose is given in two or three sittings. If three are used, treatment is given every other day. If only two are used, an interval of a week or six days is allowed. If the lesion is of the order of 2.5 or 3 cm. in diameter, the dose is reduced to around 4,000 or 4,500 r, as clinical judgment may dictate. These doses are measured in air plus the secondary radiation from the cone, *i.e.*, no allowance is made for back-scatter from the skin.

When I spoke of radiation break-down—and please do not misunderstand anything I shall say as bearing any relation to the remarkable results obtained with radon ointment—I referred to that which occurs roughly two years after treatment, unless, in the case of the larger lesions, there has been trauma, either solar or an actual bruise, when the reaction may occur earlier. Those cases that I had all healed in from two to three months, with application of *Aloe vera* jelly (40 per cent in a neat's-foot oil base) as a dressing. I have seen these late reactions following treatment of a lip cancer; I have seen them on the nose, including my own, on the crown of the head, and on the forehead. Usually they break down and look like recurrences to the patients, but I reassure them by telling them that the lesions always heal, and so far they have done so, usually with less scar than the original one.

I had an opportunity to see a case in which I believe radon ointment would have worked very well. Following definite overdosage, a large area over the wrist had broken down, so that the tendons of the thumb were exposed. The patient was a Portuguese of somewhat phlegmatic temperament, who preferred to bear the pain rather than submit to surgery. *Aloe vera* ointment was used and after a year the lesion was closing in well. The last time I saw the patient it was about 80 per cent healed. If he comes in again or I see any similar case, I shall certainly use radon ointment, but I do not think it would be necessary for the low percentage of small-area breakdowns which I have been discussing.

EDITORIAL

Presidential Address¹

In your father's time mankind was faced with a crisis. In his father's time there were grave doubts about the future of what was beginning to be called western civilization. Before him each generation was faced with seemingly insuperable problems which threatened to put an end to human progress. Let me quote a recent commentator:

"It is a gloomy moment in history. Not for many years—not in the lifetime of most men who read this—has there been so much grave and deep apprehension; never has the future seemed so incalculable as at this time.

"In our own country there is universal commercial prostration and panic, and thousands of our poorest fellow-citizens are turned out against the approaching winter without employment, and without the prospect of it.

"In France the political caldron seethes and bubbles with uncertainty; Russia hangs, as usual, like a cloud, dark and silent, upon the horizon of Europe; while all the energies, resources and influences of the British Empire are sorely tried, and are yet to be tried more sorely, in coping with the vast and deadly disturbed relations in China.

"It is a solemn moment, and no man can feel an indifference—which happily, no man pretends to feel—in the issue of events.

"Of our own troubles [in the U. S. A.] no man can see the end. They are, fortunately, as yet mainly commercial; and if we are only to lose money, and by painful poverty to be taught wisdom—the wisdom of honor, of faith, of sympathy and of charity—no man need seriously to despair.

"And yet the very haste to be rich, which is the occasion of this widespread calamity, has also tended to destroy the moral forces with which we are to resist and subdue the calamity."

These words, I said, were those of a recent commentator. The word recent, however, is a relative term, as incidentally are almost all other words we use when putting thought into language. The fact is that this doleful item is taken from the Oct. 10,

1857, issue of *Harper's Weekly*. I quote it to prove that all the woeful pessimists who warn of an approaching debacle in our civilization, who predict political nihilism, economic anarchy, and the end of medical freedom are being singularly unoriginal.

What we must get into our minds is that we live in a social environment that changes from day to day. What was true yesterday is no longer true today, neither in science, politics, nor social economics. Philosophy, embracing the laws of human intercourse, is not a science but merely a point of view at a given place, at a given time, and under given circumstances. Unless we remember this, we will be like the veteran described by Dorothy Parker, who says,

"Inertia rides and riddles me,
The which is called philosophy."

With this somewhat ponderous preface. I wish to take brief advantage of the privilege which is annually accorded your president to present, in my presidential address, a point of view which I entertain at the present time, in this place, under existing circumstances.

We who have dedicated our lives to the science of radiology have thereby adopted a philosophy. It involves certain basic principles and ethical concepts that guide us in our daily pursuits. True, like other doctors, and indeed like most other people, we are engaged in earning a livelihood. But, by reason of the fact that we are engaged in a common field of endeavor, following in common a professional practice that employs the scientific method, we have certain concepts which set us apart from all others and bind us together in a fraternal body.

It must have occurred to each of you

¹ Delivered at the Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 9-10, 1945.

at one time or another, as it has to me, that the future of our profession is clouded in a mist of imponderable unknowns. A man cannot give his life to a science without having some thoughts about its future. The history of its past kindles in us an enormous admiration for those illustrious pioneers who brought the science we follow to the point at which we took over. What of those who follow us? We took the torch from Caldwell, Carman, Hickey, Pancoast, and others. Soon, we shall pass it on to others. How will it burn then? Will they carry it forward again? Have we added to its brilliance, and will it burn more brightly in the hands of those we train today?

For myself, I entertain no doubt that the magnificent progress of this young science will continue in the future. Think what has been accomplished within the lifetime of our contemporaries! Compare the present status of neurologic roentgenology with that we knew and practised in 1910. Contrast our concept of today with that of all scientific medicine in the diagnosis of pulmonary disease. Compare the urging of proponents of the stethoscope of 1920 in the diagnosis of pulmonary tuberculosis with the recommendation of the Committee on Tuberculosis, Division of Medical Sciences, of the National Research Council, whose findings qualified the roentgen examination of the chests of all registrants under Selective Service. What of the curability of carcinoma of the cervix? Within your memory is not the attitude of our clinical friends toward roentgenology as "trick photography" in striking contrast with their requests for roentgenographic examination and their attitude of cordial co-operation?

Is there any reason to believe that progress will be any less spectacular in the next thirty years than during the period since 1910? I do not think so. I have unlimited faith in the earnest young men and women that you and I are training today. They will not all become outstanding leaders in medicine. But some of them will, and most of them will occupy a

useful position in the medical matrix that will continue to reflect credit upon our specialty.

We radiologists indulge in a justifiable pride, for our role in the diagnosis and cure of disease becomes more indispensable each year as the whole science of medicine improves and refines its technics. It is perfectly obvious to me that our service will become increasingly essential in the years ahead. It has frequently been said that modern medicine, under the influence of specialization is no longer a one-man, family-doctor affair. It is a matter of teamwork, involving several experts in most cases of serious illness. The radiologist is beginning to be recognized as one of the key men on the team. In football metaphor, he often functions as the quarterback, whose analysis of the situation determines the strategy and course of action of all other members of the team. This, of course, is the goal toward which we should strive. Our contribution to advancement in the control of disease will be greatest in those hospitals and communities where the radiologist becomes, by common consent and by virtue of his skill, the quarterback on the medical team.

If tonight we possessed a magic key with which we could unlock some of the secrets that now elude us, there would be scores of divergent suggestions as to which of the many doors still closed to us we should open.

Progress will continue if we are dissatisfied, and surely we appreciate that there is much to be done. Fluoroscopy, in the light of Dr. Chamberlain's Carman Lecture of a few years back, stimulates our imagination and renders us impatient with our present equipment. The great white plague, whose incidence we have watched decline, challenges us to a rational last offensive that can see its eradication. Cancer—its diagnosis and treatment—requires our greater attention. We have more to contribute than any specialty. Isotope therapy, the harnessing of atomic energy and other new possibilities opened in the field of nuclear physics, so ably presented

by Doctor Stone in his most challenging address, merit our earnest consideration.

Someday these doors will be opened to us by the total efforts of those among our colleagues who keep up the search, or by those in succeeding generations who follow the precepts of the modest man whose profound discovery we are this week commemorating. The man who gave birth to our specialty was questioned by a reporter after the first announcement of his discovery. What, asked the reporter of Röntgen, did he think when he observed the peculiar action of the fluorescent screen which lay near his Crookes tube. "I didn't think . . . I investigated," was the reply.

Thus, the founder of our science gave us the pattern for the continued progress of our specialty. As we go about our daily tasks, let us maintain the attitude of men of science. Let us observe; then let us investigate. In this way those things which are now concealed from us will be revealed, and the role of medical roentgenology will be expanded as rapidly as its contributions are increased.

If the future scientific progress of our specialty is assured, what about the economic problems with which we are confronted? Most thoughtful radiologists are understandably concerned with the economic and sociological questions which arise in connection with the delivery of our service to the consumer, the patient. What of the relationships between radiologists and hospitals, public welfare agencies, clinics, and insurance plans? I am optimistic on this score, also. No living person knows what the next hundred years will bring in the simple matter of man living with man. Evolution will take place in economics and political concepts as certainly as there will be evolution in scientific knowledge. The most we can do is to keep constantly vigilant, aware of developments, and informed of trends. Through effective organization we can exert our influence in shaping the course of events. This, fortunately, we in radiology are

doing. We can be proud of having acquired a reputation within the citadel of medicine for being alert and aggressive, in seeking a proper course through the currents of change that are so swift and turbulent today.

Through our labors, and the labors of our colleagues in research laboratories, we are maintaining a service which society needs and wants. While some of our brothers have carried the service of radiology behind our victorious flag to aid in achieving the magnificent victory our nation has won against the foes of western humanitarianism, those of us on the home front have carried a heavy burden. But the job has been done; soon our friends who helped win the war will lay aside their uniforms; we who met the enormous demands of civilian needs will find our burden lightened.

The number of radiologists will be greatly increased in the next ten years. This will be good not only for the welfare of the people, but for our specialty itself. The greatest weakness of radiology today, I believe, lies in the fact that there are too few of us. Too many communities have been denied the benefits of good scientific radiology. The ratio of radiologists to other practitioners should be increased from 1 in 80, as it is today, to 1 in 40. By every means possible, we should encourage capable young graduates to select radiology as a specialty and should improve facilities for their training.

It is our obligation, by precept and deed, to demonstrate the valuable and essential role of radiology in modern medical practice. This has been a familiar plea in the addresses of presidents who have preceded me in this Society. We should recognize, too, I believe, that the profession of radiology will be advanced only if we are willing individually and collectively to bend every effort toward lifting the clinical radiologist of lowest caliber to the level of the top men in our profession. The American Board of Radiology has established and is maintaining standards for the profession which must be met by all those who seek admission to

the ranks of qualified radiologists. We have, through our elected representatives that Board, influenced the continuation of the high standards demanded of those certified. We can, by attitude and example, stimulate the incompletely qualified to greater personal improvement. We can contribute, by each becoming thoroughly conversant with the stated requirements of the Board and by a helpful attitude toward the aspirant, to the maintenance of high standards. It is our duty to see that new knowledge in roentgenology is disseminated throughout the profession, promptly and widely, so that patients in every community and in every hospital will receive the very best quality of radiological service.

There is, however, a greater obligation, and this, I believe, poses a challenge for the Radiological Society of North America.

It is our duty to demand that every practitioner of radiology maintain the quality of clinical excellence that is to be found in the offices and hospitals of our leading men. In preparing our scientific meetings and in conducting the affairs of our Society, we should never lose sight of this principle. By common agreement and frequent reiteration, we should exert a moral and ethical compulsion upon every radiologist to give to his patient the finest skill, judgment, and clinical ability that is possible in the light of our present knowledge. Any radiologist who falls short of this goal does injury to the entire profession. He should be helped to attain the level that we have set for ourselves. If he is unwilling to make the necessary effort, he should be denied the respect and esteem of the members of our profession.

LEWIS G. ALLEN, M.D.

ANNOUNCEMENTS AND BOOK REVIEWS

SECOND INTER-AMERICAN CONGRESS OF RADIOLOGY

The program for the Second Inter-American Congress of Radiology, to be held in Habana, Cuba, Nov. 17-22, 1946, is now in course of preparation. This is not yet entirely filled, and members of the Radiological Society of North America who plan to attend and wish to present papers are urged to communicate immediately with Dr. James T. Case, Chairman of the General Committee for the United States, 20 No. Wacker Drive, Chicago 6, Ill. Because of the long distances involved and the time consumed in transmission by mails, promptness in this matter is of the utmost importance.

AMERICAN ROENTGEN RAY SOCIETY

The recently elected officers of the American Roentgen Ray Society are: Dr. Ross Golden, New York City, President; Dr. Raymond C. Beeler, Indianapolis, President-Elect; Dr. Francis F. Borzell, Philadelphia, First Vice-President; Dr. Ellis R. Bader, Cincinnati, Second Vice-President; Dr. H. Dabney Kerr, Iowa City, Iowa, Secretary; Dr. J. Bennett Edwards, Leonia, N. J., Treasurer.

NORTH CAROLINA RADIOLOGICAL SOCIETY

The North Carolina Radiological Society will hold its next annual meeting on May 1, at the Carolina Hotel, Pinehurst, N. C. The business session at 9:30 A.M. will be followed by a Film Reading Session, "Stump the Experts," under the direction of Dr. Fred Jenner Hodges, of the University of Michigan. The Experts will be Dr. Robert J. Reeves of Duke University, Durham, and Dr. James P. Rousseau of the Bowman-Gray Medical School, Winston-Salem. Case presentations will be given by Dr. Allan Tuggle, Dr. O. D. Baxter, and Dr. J. E. Hemphill, of Charlotte, N. C., Dr. Graham Barefoot, Wilmington, N. C., Dr. G. W. Murphy, Asheville, N. C., Dr. B. E. Rhudy, Greensboro, N. C., Dr. C. L. Gray, High Point, N. C., Dr. L. W. Oehlbeck, Morganton, N. C., and Dr. W. W. Vaughan, Durham, N. C.

At 3:00 P.M. Dr. Hodges will speak on "It Pays to Catalogue X-Ray Experiences."

PENNSYLVANIA RADIOLOGICAL SOCIETY

The next Annual Meeting of the Pennsylvania Radiological Society will be held on May 17 and 18 at the Berkshire Hotel, Reading, Penna.

GREETINGS FROM THE SOVIET UNION

There have been received through the American-Soviet Science Society cabled greetings from the radiologists of the Soviet Union on the occasion of the fiftieth anniversary of the discovery of the roentgen ray and the completion of fifty years of American roentgenology. "All Soviet roentgenologists and radiologists," the message reads, "numbering many thousands, warmly greet their overseas colleagues in the United States. Soviet biology highly appreciates the great contribution made to the treasury of world roentgenology by our American colleagues during the past half century. Soviet roentgenologists and radiologists have always closely followed the notable achievements and progress of their American coworkers in this field. We sincerely wish our American friends every success in their further work."

DAVID ANDERSON-BERRY PRIZE

At the request of the Royal Society of Edinburgh, the following announcement is brought to the attention of members of the Radiological Society of North America.

"A David Anderson-Berry Silver-gilt Medal, together with a sum of money amounting to about £100, will be awarded in 1947 by the Royal Society of Edinburgh to the person, who, in the opinion of the Council, has recently produced the best work on the therapeutical effect of X-rays on human diseases.

"Applications for this prize are invited. They may be based on both published and unpublished work and should be accompanied by copies of relevant papers.

"Applications must be in the hands of the General Secretary, Royal Society of Edinburgh, 22 George Street, Edinburgh 2, by December 1, 1946."

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

L'UROGRAPHIE INTRAVEINEUSE. By BERNARD FEY AND PIERRE TRUCHOT. A volume of 214 pages, with 242 roentgenograms. Published, 1944, by Masson et Cie, Paris. Price 320 fr.

ROENTGEN DIAGNOSIS OF DISEASES OF THE GASTRO-INTESTINAL TRACT. By JOHN T. FARRELL, JR., M.D., Clinical Professor of Radiology, Graduate School of Medicine, University of Pennsylvania.

Radiologist, Hermann Hessenbrueh Memorial Department of Radiology, The Lankenau Hospital; Radiologist, Children's Hospital of the Mary J. Drexel Home; Roentgenologist, White Haven Sanatorium; Consulting Roentgenologist, Frederick Douglass Memorial Hospital; Consulting Roentgenologist, Mercy Hospital. A volume of 271 pages, with 193 illustrations. Published by Charles C Thomas, Springfield, Ill., 1946. Price \$5.50.

Book Reviews

A TEXTBOOK OF SURGERY. By JOHN HOMANS, M.D., Clinical Professor of Surgery, Emeritus, Harvard Medical School. Compiled from Lectures and Other Writings of Members of The Surgical Department. With a Special Bibliographical Index and with illustrations by Willard C. Shepard and others. A volume of 1278 pages, with 530 figures. Published by Charles C Thomas, Springfield, Ill. Sixth Edition, 1945. Price \$8.00.

Homans' Textbook of Surgery, first appearing in 1931, has long been known and highly regarded by the general medical profession. A sixth edition of this popular one-volume Surgery now appears, incorporating, according to the publisher's statement, some 188 pages of new and revised material. To accomplish this without any increase in the bulk of the volume and with no change in the pagination, is in itself an achievement, made possible only by strict adherence to the rule that "for everything fresh that comes in, something stale must go out." Perhaps no better assurance than this of the timelessness of the work could be offered.

There is no question that this book will continue to be a favorite among teachers and students of surgery and in the working library of the busy physician. The subject matter is clearly and logically presented, and in such a manner that it is of interest not alone to the surgeon but to all who are engaged in the practice of medicine. Particular attention is paid to pathology and diagnostic features, with somewhat less emphasis than might be expected on actual treatment. The text is illustrated by 530 pen-and-ink sketches which show evidence of excellent craftsmanship. There are a comprehensive bibliography and an extensive index.

CLINICAL ROENTGENOLOGY OF THE HEART. ANNALS OF ROENTGENOLOGY, VOL. XVIII. By JOHN B. SCHWEDEL, M.D., Associate Attending Physician, Medical Division, Adjunct Attending Physician, Department of Roentgenology, Montefiore Hospital, New York; Attending Electrocardiographer and Associate Visiting Physician in Medicine, Gouverneur Hospital, New York; Lieutenant Commander, M.C. (V)S., U.S.N.R. A volume of 380 pages, with 749 illustrations in 232 figures. Published by Paul B. Hoeber, Inc., Medical Book Department of Harper & Brothers, New York, 1946. Price \$12.00.

Schwedel's Clinical Roentgenology of the Heart, the latest volume of the Annals of Roentgenology, is a worthy addition to this lengthening series inaugurated by the late Paul B. Hoeber a quarter of a century ago. In this new volume the author combines clinical observations with roentgen findings to present a clear picture of the normal and pathologic states of the cardiovascular system.

The opening chapter deals with Methods of Examination and emphasizes the value of fluoroscopy, which has the great advantages of convenience and economy, is sufficiently accurate to permit diagnosis of cardiac enlargement as early as, or earlier than, other methods, and, in addition, allows examination of the pulsation of the cardiac contours and an analysis of their amplitude, direction, and timing. This stress upon the advantages of fluoroscopic study recurs throughout the book.

Following the introductory chapter, the author takes up successively Cardiac Measurements, Normal Cardiac Contours, and Normal Variations in the Heart. Subsequent chapters are devoted to each of the chambers of the heart, to general cardiac enlargement, the aorta, the venae cavae and brachiocephalic vessels, the lungs in heart disease, the pericardium, congenital heart disease, cardiac displacement and cardiac and extra-cardiac calcifications. To each chapter is appended an excellent bibliography.

Mechanically the book is well made. It is printed on good paper and attractively bound. The illustrations are clearly reproduced and many of the roentgenograms are accompanied by pen-and-ink diagrams which add to their value.

This volume is recommended as a readable and authoritative work, a storehouse of knowledge for both clinician and roentgenologist.

RADIOLOGICAL SOCIETIES OF NORTH AMERICA

Editor's Note.—Will secretaries of societies please cooperate by sending information to Howard P. Doub, M.D., Editor, Henry Ford Hospital, Detroit 2, Mich.

UNITED STATES

Radiological Society of North America.—Secretary, D. S. Childs, M.D., 607 Medical Arts Bldg., Syracuse 2, N. Y.

American Roentgen Ray Society.—Secretary, Harold Dabney Kerr, M.D., Iowa City, Iowa.

American College of Radiology.—Secretary, Mac F. Cahal, 20 N. Wacker Dr., Chicago 6, Ill.

Section on Radiology, American Medical Association.—Secretary, U. V. Portmann, M.D., Cleveland Clinic, Cleveland 6, Ohio.

ARKANSAS

Arkansas Radiological Society.—Secretary, J. S. Wilson, M.D., Monticello. Meets every three months and annually at meeting of State Medical Society.

CALIFORNIA

California Medical Association, Section on Radiology.—Secretary, Gordon King, M.D., Children's Hospital, San Francisco.

Los Angeles County Medical Association, Radiological Section.—Secretary, Roy W. Johnson, M.D., 1407 South Hope St., Los Angeles. Meets second Wednesday of each month at County Society Building.

Pacific Roentgen Society.—Acting Secretary, Frederick H. Rodenbaugh, M.D., 490 Post St., San Francisco. Meets annually with California Medical Association.

San Diego Roentgen Society.—Secretary, Henry L. Jaffe, M.D., U. S. Naval Hospital, San Diego, Calif. Meets first Wednesday of each month.

San Francisco Radiological Society.—Secretary, Joseph Levitin, M.D., 516 Sutter St., San Francisco 2. Meets monthly on the third Thursday at 7:45 P.M., first six months of the year in Lane Hall, Stanford University Hospital, and second six months in Toland Hall, University of California Hospital.

COLORADO

Denver Radiological Club.—Secretary, A. Page Jackson, Jr., M.D., 304 Republic Bldg., Denver 2. Meetings third Friday of each month, Denver Athletic Club.

CONNECTICUT

Connecticut State Medical Society, Section on Radiology.—Secretary, Max Climan, M.D., 242 Trumbull St., Hartford 3. Meetings bimonthly, second Thursday.

FLORIDA

Florida Radiological Society.—Secretary-Treasurer, J. F. Pitman, M.D., Blanche Hotel Annex, Lake City.

GEORGIA

Georgia Radiological Society.—Secretary-Treasurer, James J. Clark, M.D., 478 Peachtree St., N. E., Atlanta 3. Meets in November and at the annual meeting of State Medical Association.

ILLINOIS

Chicago Roentgen Society.—Secretary, Fay H. Squire, M.D., 1753 W. Congress St., Chicago 12. Meets at the Palmer House, second Thursday of October, November, January, February, March, and April.

Illinois Radiological Society.—Secretary-Treasurer, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly by announcement.

Illinois State Medical Society, Section on Radiology.—Secretary, Frank S. Hussey, M.D., 250 East Superior St., Chicago 11.

INDIANA

The Indiana Roentgen Society.—Secretary-Treasurer, Harold C. Ochsner, M.D., Methodist Hospital, Indianapolis 7. Annual meeting in May.

IOWA

The Iowa X-ray Club.—Secretary, Arthur W. Erskine, M.D., Suite 326 Higley Building, Cedar Rapids. Holds luncheon and business meeting during annual session of Iowa State Medical Society.

KENTUCKY

Kentucky Radiological Society.—Secretary-Treasurer, Sydney E. Johnson, M.D., 101 W. Chestnut St., Louisville.

LOUISIANA

Louisiana Radiological Society.—Secretary-Treasurer, Johnson R. Anderson, M.D., North Louisiana Sanitarium, Shreveport. Meets annually at same time as State Medical Society.

Shreveport Radiological Club.—Secretary, Oscar O. Jones, M.D., 2622 Greenwood Road. Meets monthly September to May, third Wednesday, 7:30 P.M.

MARYLAND

Baltimore City Medical Society, Radiological Section.—Secretary, Charles N. Davidson, M.D., 101 West Read St., Baltimore 1.

MICHIGAN

Detroit X-ray and Radium Society.—Secretary-Treasurer, E. R. Witwer, M.D., Harper Hospital, Detroit 1. Meetings first Thursday of each month from October to May, at Wayne County Medical Society club rooms.

Michigan Association of Roentgenologists.—Secretary, Bruce MacDuff, M.D., 201 Sherman Bldg., Flint 3.

MINNESOTA

Minnesota Radiological Society.—Secretary, A. T. Stenstrom, M.D., Minneapolis General Hospital, Minneapolis 26. Meetings quarterly.

MISSOURI

Radiological Society of Greater Kansas City.—Secretary, John W. Walker, M.D., 306 E. 12th St., Kansas City, Mo. Meetings last Friday of each month.

St. Louis Society of Radiologists.—Secretary, Edwin C. Ernst, M.D., 100 Beaumont Medical Bldg. Meets on fourth Wednesday of each month except June, July, August, and September.

NEBRASKA

Nebraska Radiological Society.—Secretary-Treasurer, Donald H. Breit, M.D., University of Nebraska Hospital, Omaha 5. Meetings third Wednesday of each month at 6 P.M. in either Omaha or Lincoln.

NEW ENGLAND

New England Roentgen Ray Society.—Secretary-Treasurer, George Levene, M.D., Massachusetts Memorial Hos-

itals, Boston, Mass. Meets monthly on third Friday at Boston Medical Library.

NEW HAMPSHIRE

New Hampshire Roentgen Society.—*Secretary-Treasurer*, Richard C. Batt, M.D., St. Louis Hospital, Berlin.

NEW JERSEY

Radiological Society of New Jersey.—*Secretary*, H. R. Brindle, M.D., 501 Grand Ave., Asbury Park. Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called.

NEW YORK

Associated Radiologists of New York, Inc.—*Secretary*, William J. Francis, M.D., East Roekaway, L. I.

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PENNSYLVANIA

Pennsylvania Radiological Society.—*Secretary-Treasurer*, L. E. Wurster, M.D., 416 Pine St., Williamsport 8. The Society meets annually.

Philadelphia Roentgen Ray Society.—*Secretary*, Calvin L. Stewart, M.D., Jefferson Hospital, Philadelphia 7. Meets first Thursday of each month at 8:00 P.M., from October to May, in Thomson Hall, College of Physicians, 21 S. 22d St.

Pittsburgh Roentgen Society.—*Secretary-Treasurer*, Lester M. J. Freedman, M.D., 4800 Friendship Ave., Pittsburgh 24. Meets second Wednesday of each month at 6:30 P.M., October to May, inclusive, at The Ruskin, 120 Ruskin Ave.

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University of Wisconsin Radiological Conference.—Meets first and third Thursdays, 4 to 5 P.M., September to May, inclusive, Room 301, Service Memorial Institute, 426 N. Charter St., Madison 6.

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CUBA

Sociedad de Radiología y Fisioterapia de Cuba.—*Offices* in Hospital Mercedes, Havana. Meets monthly.

ABSTRACTS OF CURRENT LITERATURE

ROENTGEN DIAGNOSIS

The Head and Neck

- KOSTRUBALA, JOSEPH G. Potential Anatomical Spaces in the Face..... 293
- ARANA, ROMAN, AND ASENJO, A. Ventriculographic Diagnosis of Cysticercosis of the Posterior Fossa..... 293
- FROSTBERG, NILS. Roentgen Picture in Mucopyocle and Cholesteatoma in the Frontal Sinus. 293
- BOYD, HAROLD M. E. Congenital Atresia of the Posterior Nares. Descriptions of Techniques Used in Meeting the Operative Difficulties and Report of a Case..... 293
- KLAFF, DANIEL D. Bilateral Congenital Atresia of the Choanae..... 294
- COHN, BERNARD N. E. True Oxycephaly with Syndactylism. Case Report..... 294

The Chest

- REISNER, DAVID, AND DOWNES, JEAN. Minimal Tuberculous Lesions of the Lung: Their Clinical Significance..... 294
- PLATT, WILLIAM R., AND WARD, CHARLES S., JR. Cold Isohemagglutinins: Their Association with Hemolytic Anemia and Multiple Thromboses in Primary Atypical Pneumonia. A Brief Review of the Clinical and Laboratory Problems Involved..... 294
- HIRSCH, EDWIN F., AND RUSSELL, HOMER B. Chronic Exudative and Indurative Pneumonia Due to Inhalation of Shellac..... 295
- MOVITT, E. R. Spontaneous Pneumothorax as a Complication of Pneumonia in Adults..... 295
- RIEMER, ALLEN D. Egg-Shell Calcifications in Silicosis..... 295
- LESTER, CHARLES W. Pulmonary Abscess, Acute and Chronic..... 295
- HUSSEY, HUGH H., AND KATZ, SOL. Septic Pulmonary Infarction: Report of Eight Cases.. 295
- MAYER, EDGAR, AND RAPPAPORT, ISRAEL. Pulmonary Emphysema—Newer Concepts.... 296
- GROSS, ROBERT E., AND LEWIS, JAMES E., JR. Defect of the Anterior Mediastinum: Successful Surgical Repair..... 297
- PENDERGRASS, ROBERT C. Cardiac Changes in Arteriovenous Fistula..... 297
- STEMMERMAN, MARGUERITE G. Silicosis of the Pericardium. Case Report..... 297

The Digestive System

- HUSSEY, FRANK L. Value of Spot Films in Radiography of the Gastro-Intestinal Tract. 297
- SKARBY, HANS-GÖSTA. Clinical and Roentgenologic Diagnosis of Foreign Bodies, Especially Fish Bones, in the Hypopharynx and Esophagus, with Discussion of a Suitable Roentgenologic Method..... 298

- HANSSON, C. J. Varices of the Oesophagus in Children..... 298
- HARPER, R. A. KEMP, AND TISCENCO, EUGENE. Benign Tumor of the Oesophagus and Its Differential Diagnosis..... 298
- HOWARD, JOHN T. Experiences with the Gastroscope Over a Period of Six Years..... 298
- AARON, A. H. Inflammatory Lesions of the Upper Gastrointestinal Tract..... 298
- TORGENSEN, JOHAN. Localization of Gastritis and Gastric Cancer, Especially in Cases of Pernicious Anemia..... 298
- SYLVÉN, BENGT. Localized Acute Oedematous Gastritis Resembling Carcinoma..... 298
- NICHOLAS, F. G. Review of Three Gastric Cases with Positive Radiological and Negative Laparotomy Findings..... 298
- CRYMBLE, P. T. Ulcer of the Second Part of the Duodenum..... 298
- RUFFIN, JULIAN M., BAYLIN, GEORGE J., AND CAYER, DAVID. Clinical Significance of Alteration of the Small Intestine Pattern as Demonstrated by X-Ray..... 298
- ISBISTER, JAMES. A Case of Sprue Syndrome... 298
- FRASER, KENNETH. Malignant Tumours of the Small Intestine. Review of the Literature and Report of 21 Cases..... 298
- DMYTRYK, EUGENE T. Congenital Malformations of the Anus and Rectum: Clinical Study..... 298
- ASPRAY, MELVIN. Calcified Hemangiomas of the Liver..... 298
- RUDSTRÖM, PAUL. Cholangiograms in Intrahepatic Processes..... 298
- McHARDY, GORDON, AND BROWNE, DONOVAN C. Gall Stone Ileus..... 298

The Musculoskeletal System

- TENNENT, WILLIAM. Plasmocytoma of Bone... 298
- MARBLE, HENRY C., AND BISHOP, WILLIAM A. Intervertebral Disc Injury: Analysis from an Industrial Standpoint..... 298
- MOONEY, A. CRAIG. Disc Lesions in Relation to Pain..... 298
- PEACHER, WILLIAM G., AND ROBERTSON, ROBERT C. L. Pantopaque Myelography: Results, Comparison of Contrast Media, and Spinal Fluid Reaction..... 298
- ARNELL, SIGFRID. Further Experience with Myelography with Abrodil..... 298
- HYMAN, GEOFFREY. Case of Pseudarthrosis Following Fractures of the Lumbar Transverse Processes..... 298
- TALBOT, NATHAN B., BUTLER, ALLAN M., PRATT, EDWARD L., MACLACHLAN, E. A., AND TANNHEIMER, J. Progeria: Clinical, Metabolic and Pathologic Studies on a Patient.... 298

IRELLI, FRANK J., AND GREEN, GEORGE G.	
Renal Rickets—A Case Report.....	303
RAY, TINA. Osteomyelitis of the Clavicle.....	304
ROSSMAN, J. W., AND MINOR, HOWARD H.	
Roentgen Demonstration of the Semilunar	
Cartilages of the Knee.....	304
ICKLEY, E. JAMES. Pellegrini-Stieda Disease..	304
IE, H. G. Radioulnar Synostosis of Traumatic	
Origin: Report of a Case.....	304
OBURN, DONALD E. Delayed Rupture of the	
Extensor Pollicis Longus Tendon Following	
Colles's Fracture.....	304
ENRY, M. G. Anomalous Fusion of the Sca-	
phoid and the Greater Multangular Bone..	305
OWLER, A., AND PHILIP, J. F. Abnormality of	
the Calcaneus as a Cause of Painful Heel.	
Its Diagnosis and Operative Treatment....	305
LAINE, H., BENNETT, G. A., AND BAUER, W.	
Joint Disease Associated with Acromegaly..	305
ADNER, STIG. Roentgenological Changes in	
Lead Poisoning in Children.....	305
Gynecology and Obstetrics	
POWMAN, ROBERT M., AND KUSHLAN, SAMUEL D.	
"The Krukenberg Tumors." The Roentgen	
and Gastroenterological Aspects of Second-	
ary Ovarian Carcinoma.....	306
BEYNS, O. S. Studies in X-ray Pelvimetry: An	
Evaluation of Pelvic Radiography with a	
Plea for Simplicity.....	306
The Genito-Urinary Tract	
OLIN, HARRY A. Excretion Urography, Its	
Value in the Diagnosis of Renal Diseases..	307
VASTINE, JACOB H., 2D, AND VASTINE, MARY	
FRANCES. Subcutaneous Urography.....	307
HYMAN, A. Renal Lithiasis and Its Treatment..	307
FRIEDMAN, LEWIS J., AND FRIEDMAN, PAUL S.	
Inflammatory Lesions of the Kidneys.....	307
REXFORD, W. K., AND CONNOLLY, PAUL J.	
Traumatic Infarction of the Kidney.....	308
NICHOLS, BERNARD H. Anomalies of Ureters	
and Kidneys as Observed by Radiologist..	308
MOE, RUSSELL J. Duplication of Right Kidney	
Pelvis and Ureter with Extravesical Ureteral	
Opening.....	308
SOLIS-COHEN, LEON, AND LEVINE, SAMUEL.	
Renal Dystopia.....	309
NATION, EARL F. Renal Ectopia. A Study of	
Twenty-Three Cases.....	309
CORAY, QUINCE B. Crossed Renal Ectopia....	309
KERSHNER, DAVID, AND KESSLER, LEON N.	
Solitary Cyst of the Kidney. Case Report..	310
MCGRIGOR, D. B., AND SAMUEL, ERIC. Radiol-	
ogy of War Injuries. Part II. War Wounds	
of the Urinary Tract.....	310
The Soft Tissues	
FRANTZELL, ARNE. Roentgenologic Soft-Tissue	
Studies of the Skin and Subcutaneous Tissue:	
A Contribution to the Roentgen Study of	
Edema.....	310

The Blood Vessels

JACKMAN, JAMES, AND LUBERT, MORTIMER. Sig-	
nificance of Calcification in the Ascending	
Aorta as Observed Roentgenologically.....	310
BILLING, LARS, AND LINDGREN, ÅKE G. H.	
Pathological-Anatomical Basis of Tumor	
Arteriography. An Investigation of the	
Arterial Vessels of Hypernephromas and	
Carcinomas of the Stomach.....	311
GOETZ, ROBERT H. Classification and Diagnosis	
of Peripheral Vascular Diseases.....	311
CANDEL, SAMUEL. Varicose Veins of the Upper	
Extremity. Report of Two Cases.....	311

Technic

OLSSON, OLLE. A Method for the Radiography	
of Superficial Layers (Superficial Tomography	
by Vertical Tube Motion).....	312
SUNDBERG, C. G., AND LINDHOLM, STIG. Forma-	
tion of Layer Images in Roentgen Diagnosis.	312
LYSHOLM, ERIK. A Fluorescent Screen Lamina-	
graph.....	312

RADIOTHERAPY

Neoplastic Disease

DAVIS, E. D. D., COLLEDGE, LIONEL, LEDERMAN,	
M., ET AL. Discussion on Treatment of	
Carcinoma of the Larynx.....	312
ADAIR, FRANK E., TREVES, NORMAN, FARROW,	
JOSEPH H., AND SCHARNAGEL, ISABEL M.	
Clinical Effects of Surgical and X-Ray	
Castration in Mammary Cancer.....	312
REEVES, ROBERT J. Round Cell Tumor of Bone	
Resembling Ewing's Tumor.....	313
BEECHAM, CLAYTON T., AND MONTGOMERY,	
THADDEUS L. Organization and Adminis-	
tration of a Gynecologic Tumor Clinic, with	
Certain Observations Concerning Therapy.	313
SCHMITZ, HERBERT E., SHEEHAN, JOHN F., AND	
TOWNE, JANET E. Diagnosis and Treatment	
of Carcinoma of the Fundus Uteri.....	313
PARKS, THOMAS J. Carcinoma of the Ovary	
Treated Preoperatively with Deep X-Ray.	
Report of Three Cases.....	314
CADE, STANFORD, AND STEBBING, F. G. Dis-	
cussion on the Radiotherapy of Tumours of	
the Kidney and Bladder.....	314
MANDEVILLE, FREDERICK B., AND NELSON,	
CHARLES M. Wilms' Tumor of Kidney with	
Five-Year Survival Following Preoperative	
Roentgen Therapy and Nephrectomy.....	314
HOWARD, J. C. Carcinoma of the Prostate.....	315
FRANK, C. H. Malignant Tumors of the Testis.	315
POHLE, ERNST A., AND CLARK, ELIZABETH A.	
Multiple Cavernous Hemangiomas of the	
Skin, Brain and Skeleton: Report of Case	
Treated by Roentgen Rays and Observed for	
7 1/2 Years.....	315

Non-Neoplastic Disease

JAFFE, HENRY L. Evaluation of Roentgen Therapy in Filariasis..... 315

AHLBOM, HUGO. Case of Polymyositis Treated with Roentgen Rays..... 316

LEVIN, OSCAR L., AND BEHRMAN, HOWARD T. Roentgen Ray Therapy of Mycosis Fungoides. 316

OSBORN, S. B., TAVENER, DIANA R., AND FARMER, F. T. Dosage Distribution in the Treatment of Ringworm by X-Rays..... 316

MAYER, EDGAR. Light and X-Ray Therapy of Tuberculosis..... 316

EXPERIMENTAL STUDIES

TSUKER, MARIE B. Radiotherapy and Intracranial Pressure..... 317

GLUCKSMANN, A., TANSLEY, K., AND WILSON, C. W. Effect of Variations in the Dose Rate of Gamma Radiation on Cell Degeneration in the Frog Tadpole..... 317

SPEAR, F. G., AND TANSLEY, K. Action of Neutrons on the Developing Rat Retina... 317

SPEAR, F. G. Action of Neutrons on Bacteria.. 318

REED, C. I., AND REED, B. P. Evidence of the Peripheral Action of Vitamin D from X-Ray Diffraction Studies..... 318

ALLEN, HARRY, HEMPELMANN, L. H., JR., AND WOMACK, NATHAN A. Effect of Insoluble Radiophosphorus (Chromium Phosphate) When Applied Interstitially in the Treatment of Adenocarcinoma of the Mamma in Mice..... 318



ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Potential Anatomical Spaces in the Face. Joseph G. Ostrobrala. *Am. J. Surg.* 68: 28-37, April 1945.

The interpretation of the clinical findings and the surgical approach in deep infections of the face depend on accurate knowledge of the anatomy of the face, the fasciae, and potential spaces which may harbor infection. The author carried out studies on 10 cadavers. Dissection, with special attention to the possible spaces and fascial distribution, was done, with subsequent injection of a mixture of gelatine, water, and red lead, followed by roentgenography. Because the great majority of infections of the face originate from the oral cavity and associated structures, the sites for injection were determined by the suspected points of origin of an infection. The injected specimens were x-rayed, frozen, and then sectioned. Photographs and roentgenograms are reproduced.

The following spaces, found by this method, are described in detail: (1) temporal, (2) infratemporal, (3) retrozygomatic, and (4) buccal. These spaces are not entirely bounded by fascia; bones, muscles, fascia, and skin contribute to their intricate make-up. It is generally agreed that the fasciae and their distribution play an important role in infections, either by limiting them in confined compartments or by directing the spread of purulent material along planes or sheaths from one area to another. The confusing clinical picture so frequently observed in infections of the face results from the complicated distribution of the deep fascia and its relation to the various spaces described above.

Dental and paradental infection, for example, reaching the buccal space may take any of the following routes: (1) It may become subcutaneous and spread over one entire side of the face and at times into the neck and pectoral region beneath the superficial fascia. (2) Because of the direct communication present, the infection may enter the infratemporal space. (3) It may extend directly upward beneath the zygoma and involve the retrozygomatic space, and from there, (4) the temporal space may be involved. (5) Less frequently the infection spreads along the buccopharyngeal fascia and invades the parapharyngeal space. Infections originating in the temporal space may by downward progress involve the infratemporal and retrozygomatic spaces and from there the buccal and parapharyngeal spaces.

Ventriculographic Diagnosis of Cysticercosis of the Posterior Fossa. Roman Arana and A. Asenjo. *J. Neurosurg.* 2: 181-190, May 1945.

At the Instituto Central de Neurocirugía, Santiago, Chile, during a period of three and a half years, 25 cases of cysticercosis of the brain were encountered among 202 intracranial tumors. Twenty cases of infratentorial cysticercosis were studied by ventriculography. In 13 cases the lesion was located in the posterior fossa and in 7 there was a single cysticercosis of the fourth ventricle. All cases were verified surgically or at autopsy.

The ventriculographic findings in the 13 cases of cysticercosis of the posterior fossa were similar to those in tumors of that region, i.e., (a) bilateral hydrocephalus of the whole supratentorial system; (b) slight

and symmetrical dilatation, with only some variations in form; (c) dilatation of the foramen of Monro; (d) dilatation of the third ventricle with maintenance of the suprapineal recess, anterior commissure, posterior commissure, and massa intermedia.

Any intracerebellar tumor means an expanding and progressive process that sooner or later causes a complete obliteration of the aqueduct. According to its localization, displacement of this channel is upward, downward, to the right or left, forward, or backward. It has a characteristic appearance: the obliterating point is outlined definitely and precisely. Passage of air to the posterior cisterna is rare. In cysticercosis, the picture is characterized by (a) dilatation of the aqueduct of Sylvius (up to 1 cm.) with absence of deviation; (b) only partial obliteration of the aqueduct (there is always some filling of the aqueduct and fourth ventricle); (c) good passage of air to the cisterna magna; (d) presence of air around the cerebellum as a consequence of the atrophy of that region.

The ventriculograms in the 7 cases of cysticercosis of the fourth ventricle resembled those of cysticercosis of the posterior fossa. Complete obliteration of the aqueduct is rare, while there is practically always free passage of air to the cisterna magna. In two of the authors' cases, the outline of the Cysticercus within the aqueduct could be seen.

Ventriculograms from 4 cases are reproduced.

Roentgen Picture in Mucopyocele and Cholesteatoma of the Frontal Sinus. Nils Frostberg. *Acta radiol.* 25: 493-503, Nov. 21, 1944. (In German.)

Seven cases of mucocoele and pyocoele of the frontal sinuses are reported. Mucocoele occurs most commonly in the frontal sinus or ethmoid cells. It is rare in the sphenoids or antra. There is characteristically an expansive radiolucency of the sinus, with thinning of the bony walls and a tendency to growth. Pyocoele produces a similar appearance, and in the case of the frontals an extracranial pneumatocoele may be deceptive. The tendency to expand is a most important diagnostic sign. Mucocoele arising in the ethmoid region and projecting into the frontal sinuses may produce a polyp-like shadow.

Cholesteatoma may produce an identical picture, and roentgenograms of such a case, proved by operation, are reproduced. An axial projection of the frontals is recommended as an especially informative view; the teeth should be projected just in front of the sphenoid sinuses.

LEWIS G. JACOBS, M.D.

Congenital Atresia of the Posterior Nares. Descriptions of Technics Used in Meeting the Operative Difficulties and Report of a Case. Harold M. E. Boyd. *Arch. Otolaryng.* 41: 261-271, April 1945.

Atresia of the posterior nares is a condition characterized by closure of one or both posterior choanae. The obstructing partition may be complete or incomplete and may be membranous, membrano-osseous, or osseous. This condition should be suspected in all newborn infants with difficulty in breathing. Unilateral atresia seldom if ever constitutes an emergency. Complete bilateral atresia always presents an emergency and requires prompt diagnosis and expert care.

Choanal atresia in later years is easily diagnosed. It

The authors point out that functional emphysema is manifested largely by physical signs, while structural emphysema will be demonstrable chiefly by x-ray. Diagnosis must include a judicious consideration of both approaches.

The clinical picture and the diagnostic features, as well as the treatment of the various forms, are dealt with in some detail.

PERCY J. DELANO, M.D.

Defect of the Anterior Mediastinum: Successful Surgical Repair. Robert E. Gross and James E. Lewis. *r. Surg., Gynec. & Obst.* 80: 549-554, May 1945.

The authors survey the literature regarding openings in the anterior mediastinum with direct communication between the two pleural cavities. Their case is the eleventh to be reported and apparently the first where the anterior mediastinal opening has been surgically repaired. A brief discussion of the embryologic and anatomic considerations dealing with the formation of the lungs and mediastinum prefaces the case report.

The patient, a girl seven weeks old, had experienced intermittent respiratory difficulty since birth. Physical examination revealed obvious respiratory distress with a tympanic percussion note and diminished breath sounds over the superior half of the right chest. On the left side, percussion dullness and diminished breath sounds were present over the apex anteriorly and posteriorly.

Laboratory findings were negative. Roentgenograms suggested a congenital cyst of the right lung, which was thought to communicate with a bronchus having a ball-valve obstruction. This structure extended over behind the sternum and well to the left of the midline, with displacement of the heart to the left. The right middle and lower lobes were atelectatic.

On the ninth day in the hospital, the thorax was explored and a markedly emphysematous right upper lobe was seen, which went well over on the right side of the chest. The anterior mediastinum was absent. The pericardium and great vessels formed the posterior wall of the opening between the two pleural spaces and the right lung could be viewed directly. Because the child's condition became critical, nothing more was done at this time and the chest was promptly closed.

The course of this case for the next four years was one of intermittent episodes of respiratory distress with frequent roentgenographic examinations showing what has been cited above.

When the patient was four years old, it was decided to reattempt correction of the congenital defects present in the chest. The mediastinal defect was closed by suturing the pericardium and great vessels to the posterior surface of the sternum, after which a right upper lobectomy was performed. At operation the right upper lobe bronchus was quite small and could be seen to expand and collapse during respiration.

A year has elapsed since operation, and the patient has been entirely well and asymptomatic. Check-up roentgenograms show the heart in normal position with the left lung fully expanded and the right pleural cavity filled by the remaining right lower and middle lobes.

N. P. SALNER, M.D.

Cardiac Changes in Arteriovenous Fistula. Robert C. Pendergrass. *Am. J. Roentgenol.* 53: 423-431, May 1945.

One of the most frequent and serious vascular injuries of modern warfare is arteriovenous fistula. Its

effects on the circulation in general and the heart in particular are so important that the attention of roentgenologists should be called to the cardiac changes incident to the lesion. These changes are usually reversible by elimination of the fistula. It is important to note that the cardiac manifestations of arteriovenous aneurysms resulting from wounds incurred in this war may be evident only after a long time interval, that is, after the soldier is discharged. Any patient exhibiting cardiac enlargement without obvious cause, who has received battle injuries, should be carefully examined for an arteriovenous fistula.

In a study of 24 cases the author found no appreciable change in cardiac size resulting from temporary occlusion of the fistula. Roentgenoscopically, the heart could be seen to slow its rate and increase the amplitude of its contractions. The immediate postoperative effect is an increase in heart size, with a decrease beginning in twenty-four hours, more evident at forty-eight hours, and usually well established by the seventh postoperative day.

As cardiac dilatation and hypertrophy, with eventual failure, may result from the establishment of this lesion, it is important that roentgenologists should be familiar with the cardiac effect and suspect the presence of a fistula in these patients. Case reports with illustrations of heart shadows before and after operation for elimination of the aneurysm are given.

CLARENCE E. WEAVER, M.D.

Silicosis of the Pericardium. Case Report. Marguerite G. Stemmerman. *Am. Heart J.* 29: 642-647, May 1945.

The case history is given of a 51-year-old white male, a stone cutter, who died of silicotuberculosis. Post-mortem study revealed silicotic foci in the visceral pericardium, but none in the myocardium. These were thought to be responsible for a non-infectious adhesive pericarditis. "The pericardial cavity was completely obliterated by thin, fibrous adhesions except in the atria and a portion of the left ventricle posteriorly, where the adhesions were thick, firm, and impossible to separate except by sharp dissection. The parietal pericardium was adherent almost completely to the left parietal pleura posteriorly. Microscopic examination... revealed silicotic foci within the visceral pericardium."

The deposition of the silica particles in the pericardium is attributed to a communication of the lymphatics within the pleuro-pericardial adhesions. The physical and irritative characteristics of the siliceous particles may have been responsible for the adhesive pericarditis.

HENRY K. TAYLOR, M.D.

THE DIGESTIVE SYSTEM

Value of Spot Films in Radiography of the Gastro-Intestinal Tract. Frank L. Hussey. *Illinois M. J.* 87: 242-244, May 1945.

The author finds spot films useful in the demonstration of esophageal lesions, including diverticula, carcinomata, and particularly small ulcers in the lower end of the esophagus, in which later films may fall short of revealing the lesion as well as it had earlier been shown fluoroscopically. Also, extrinsic pressure defects, shown most clearly with optimum positioning of the patient, are often best demonstrated with spot films.

In ulcers in the wall of the stomach, the defect is

often seen only in a particular position, and with a certain amount of barium in the stomach; here again spot films are often invaluable.

The author gives a comprehensive review of many of the other gastro-intestinal lesions in which he has found spot films to be of value.

PERCY J. DELANO, M.D.

Clinical and Roentgenologic Diagnosis of Foreign Bodies, Especially Fish Bones, in the Hypopharynx and Esophagus, with Discussion of a Suitable Roentgenologic Method. Hans-Gösta Skarby. *Acta radiol.* 25: 796-824, Nov. 21, 1944. (In German.)

Perforating foreign bodies are usually found in the upper portion of the esophagus. Food masses often lodge at the site of a stricture or tumor, but the normal esophagus will pass astonishingly large objects, so that they are not often impacted.

The roentgen diagnosis of foreign bodies presents many difficulties, especially when the objects are very tiny, as fish bones. For this reason Laurell's technic is recommended. This calls for a very long focal-film distance, at least 1.5 meters (5 feet), to produce maximum sharpness. It is also important to use a small field size, a small focal spot, and the shortest possible part-film distance.

Of 119 cases observed, 102 were studied roentgenologically, and these form the basis of the present report. In 90 cases the foreign body had lodged in the hypopharynx or above the jugular notch. In the others the sites of predilection were the crossing of the aortic arch and the cardia. Of 34 cases in which the body was a fishbone, 15 showed shadows of the bone, 11 showed localized swelling, 4 showed air in the soft tissues, 16 showed adherent collections of contrast medium on the bone, 17 showed local widening of the esophagus, and 6 showed a filling defect on contrast examination. A full discussion of the clinical aspects and of treatment is included.

LEWIS G. JACOBS, M.D.

Varices of the Oesophagus in Children. C. J. Hansson. *Acta radiol.* 25: 507-513, Nov. 21, 1944. (In English.)

Varices of the esophagus, giving rise to severe hemorrhage, may be the result of a thrombosis in the splenic vein. The latter condition causes an excess of blood in the vein, in consequence of which the spleen becomes enlarged, leading in turn to a distention of the veins in the lower end of the esophagus and varices in that segment of the alimentary canal. Infection seems to be a factor in producing the obstruction. Thrombosis of the splenic vein is characterized by three dominant symptoms, *viz.*, splenomegaly, ascites, and varices of the esophagus. Ascites is sometimes absent, and splenomegaly cannot always be established directly after a hemorrhage. Varices of the esophagus, however, can be demonstrated easily and effectively by roentgen examination. In cases of unexplained hemorrhages in children, therefore, roentgenograms of the esophagus should always be taken.

Three cases are presented. One of these patients had an umbilical infection.

Benign Tumor of the Oesophagus and Its Differential Diagnosis. R. A. Kemp Harper and Eugene Tiscenco. *Brit. J. Radiol.* 18: 99-107, April 1945.

The differential diagnosis between an intrinsic and an extrinsic tumor of the esophagus may be difficult.

Therefore, the radiologist should not be satisfied with merely reporting a defect but should try to demonstrate the entire extent and character of the lesion. Since the symptomatology of benign esophageal neoplasms may be trifling, or the tumor may even be discovered by accident during a routine examination, the roentgen study assumes primary importance in the diagnosis.

The symptoms of extramucosal tumors in the order of frequency are: intermittent dull retrosternal pressure or aching, epigastric pain after meals, anorexia, intermittent dysphagia, water brash, sometimes blood-tinged, vomiting, and weight loss. The roentgen signs of these tumors are: a smooth lobulated filling defect without obstruction, splitting of the barium column, normal mucosal folds adjacent to the defect, a ring-like appearance of the barium column at the end of the defect. The surface of the lesion is smooth, showing an absence of ulceration; an extrinsic soft tissue mass can sometimes be demonstrated. As these signs are not entirely typical of benign tumor, however, confirmation should be sought by esophagoscopy and biopsy.

One case is presented. SYDNEY J. HAWLEY, M.D.

Experiences with the Gastroscope Over a Period of Six Years. John Tilden Howard. *South. M. J.* 38: 293-302, May 1945.

This paper presents individual experiences and general impressions of gastroscopic studies with interesting case examples. Direct observation of proved gastric carcinomas contributes valuable information regarding the nature and extent of the lesion. One case in which repeated roentgen studies showed hypertrophic rugae on the greater curvature near the fundus of the stomach proved to be a carcinomatous ulcer (later removed) on gastroscopic examination. In another instance a diagnosis of carcinoma of the fundus was made by the roentgenologist but gastroscopic findings were negative and no lesion was found at operation. A Negro patient showed normal gastroscopic findings but at autopsy was found to have an ulcerating leiomyoma 2 inches in diameter on the posterior wall of the body of the stomach. She presumably died of massive hemorrhage. The author has often been unable to see a proved gastric ulcer but, when one is clearly visualized, differentiation from carcinoma can often be made.

It is often found impossible to correlate gastroscopic findings of gastritis with the patient's symptoms. It has been a striking observation that in definite cases of gastritis a simple sedative such as phenobarbital is most effective.

A case of tuberculosis of the stomach was observed gastroscopically on three occasions. The patient died of a tuberculous peritonitis.

The author feels that only rarely does gastroscopy reveal a lesion that is not demonstrated radiographically; yet gastroscopy has proved a useful adjunct to the x-ray examination. A negative gastroscopic study does not exclude a lesion. Excellent illustrations are included.

MAX MASS, M.D.

Inflammatory Lesions of the Upper Gastrointestinal Tract. A. H. Aaron. *J. A. M. A.* 127: 1027-1030, April 21, 1945.

In a discussion of the advances in the diagnosis and treatment of lesions of the stomach and duodenum

during recent years, the author gives the following criteria for healing of ulcerating lesions of the stomach: (1) a complete cessation of all symptoms, (2) maintenance or a gain in weight, (3) persistent absence of occult blood in the feces, (4) disappearance of anemia of the iron deficiency and essential factor type, (5) a normal sedimentation rate, (6) roentgenologic evidence of complete healing, (7) if possible, gastroscopic confirmation of healing.

Mass roentgenography of persons showing no gastric symptoms seems a logical step in the detection of early lesions of the stomach and duodenum. Peptic ulcer in childhood is often overlooked. Children with continued digestive disturbances should have upper gastro-intestinal roentgen studies to reveal or rule out the presence of this lesion. Hypermotility and irritability of the stomach in young people with a certain psychiatric make-up offers fertile ground for the formation of peptic ulcer.

In the author's opinion, peptic ulcer has been undertreated rather than overtreated. For early cases he advocates a "dietetic-educational" plan—with emphasis on the timing of meals and removal of the psychosomatic factors by application of simple psychological principles to the individual case. Medical treatment and indications for surgery are discussed.

Localization of Gastritis and Gastric Cancer, Especially in Cases of Pernicious Anemia. Johan Torgersen. *Acta radiol.* 25: 845-855, Nov. 21, 1944. (In English.)

The location of the tumor was studied in 400 unselected cases of gastric cancer and 106 cases of cancer of the stomach associated with pernicious anemia. Fifty-eight per cent of the 400 cancers were found in the region of the pyloric glands, 33 per cent in the region of the fundus glands, and 7.5 per cent on the greater curvature. These figures agree with those of other investigators and show that cancer, as well as ulcer and gastritis, is found most frequently in the pyloric region. In the 106 cases of gastric cancer with pernicious anemia, the tumor was located in the region of the pyloric glands in 33 patients, in the glands of the fundus in 66, on the greater curvature in 27, and infiltrating the entire stomach in 7 patients. Thus a location in the region of the fundus is more frequent in cancer with pernicious anemia than in cancer generally. The distribution of the cancers in cases of pernicious anemia follows the distribution of the gastritis, as in the case of cancer alone. These observations are held to support the view that gastritis plays a primary role in gastric cancer.

Localized Acute Oedematous Gastritis Resembling Carcinoma. Report of Two Cases. Bengt Sylvén. *Acta radiol.* 25: 835-839, Nov. 21, 1944. (In English.)

Two cases of localized acute edematous gastritis, with findings strongly suggestive of cancer, are presented. In each patient, check-up roentgenograms after a few weeks showed a disappearance of the tumor-like defect observed in the original films. Such a gastritis often appears after excessive use of alcohol.

Review of Three Gastric Cases with Positive Radiological and Negative Laparotomy Findings. F. G. Nicholas. *Brit. J. Radiol.* 18: 113-115, April 1945.

Three cases are reported showing positive x-ray findings which were not confirmed at operation. The

patients were followed, however, and subsequently shown to have disease. Two of the patients also had positive findings on gastroscopy. One was a case of carcinoma, one of polyposis, and one of ulcer.

In spite of the smallness of the series, the significance of this report justifies its being read by all surgeons and radiologists.

SYDNEY J. HAWLEY, M.D.

Ulcer of the Second Part of the Duodenum. P. T. Crymble. *Brit. J. Surg.* 32: 500-502, April 1945.

Four cases of ulcer of the second portion of the duodenum are recorded. In only one instance (Case I) did x-ray examination permit a correct preoperative diagnosis. In the second case the x-ray revealed a hyperperistaltic stomach and complete absence of any duodenal shadow. At operation no gastric or duodenal ulcer was found. About one year later the patient had a severe hematemesia. The opaque meal at this time again showed a normal stomach and absence of the duodenal cap. Six months later there was severe gastric dilatation with retention. At operation an ulcer was found on the anterior wall of the upper part of the descending duodenum. This case illustrates the difficulty of detecting the ulcer early, owing to its attachment to the pancreas. There is always the uncertainty as to whether a suspected thickening is ulcer or pancreas.

The third patient had a large dilated stomach with complete six-hour retention. An ulcer was found, on operation, at the second portion of the duodenum. There was complete relief of symptoms following a posterior gastroenterostomy.

The fourth case gave a history of ulcer of thirteen years' duration. The opaque meal revealed a normal stomach with no filling of the duodenum. An ulcer of the second portion of the duodenum was found at operation.

The author stresses the importance of palpation of the second portion of the duodenum on surgical exploration. This portion lies retroperitoneal, posterolateral to the head of the pancreas, and behind the gallbladder. Only the palpable ulcer can be recognized, but this is the one which is suitable for operation.

MAX CLIMAN, M.D.

Clinical Significance of Alteration of the Small Intestine Pattern as Demonstrated by X-Ray. Julian M. Ruffin, George J. Baylin, and David Cayer. *Gastroenterology* 4: 289-295, April 1945.

In an effort to determine the relationship between alteration of the small intestine pattern and the clinical picture of a deficiency state, a study was made of 73 persons. Eighteen served as normal controls; there were 31 cases diagnosed clinically as a B-complex deficiency; 10 as sprue; 5 as pernicious anemia; and 9, with no evidence of organic disease, as neurasthenia. The controls were medical students, all apparently in good health. The diagnosis of vitamin deficiency was made only in those patients having a history of an inadequate diet, with such symptoms as glossitis, papillary atrophy, cheilosis, or peripheral neuritis. The usual criteria were employed in the diagnosis of pernicious anemia and sprue.

All patients were hospitalized and given a standard diet, low in vitamins but adequate in proteins and calories. The 18 controls received the same diet but were allowed to continue their usual activities. The following studies were carried out: complete history

and physical examination, including a careful neurological examination, complete blood count, urinalysis, total proteins and A/G ratio, and stool examination for parasites. The plasma levels of vitamin A and C and carotene were determined. Nicotinic acid, thiamin, riboflavin, and pyridoxine were measured in the urine before and after test doses. Following administration of a barium meal, each patient was followed fluoroscopically and with films at regular intervals until the entire intestinal tract was visualized. Whenever possible, 24-hour films were obtained. All films were made at one-half second exposure using the Potter-Bucky diaphragm.

The x-ray findings were classified as normal, mild, moderate, or severe, depending upon the degree of change. The most severe changes were found in those patients having sprue or a frank vitamin deficiency. Definite x-ray changes, however, were noted in 3 patients classified as neurasthenics and in 5 apparently normal students. The studies were repeated in nine months in 2 of the 5 students, and the findings were entirely normal, suggesting that normal subjects may at times show alteration in the intestinal pattern and that this, taken alone, should not be construed as evidence of a latent deficiency. In general, the more severe the deficiency the more marked were the small intestine changes, and *vice versa*.

Within the group of deficiency patients, a comparison of the vitamin levels of those having x-ray changes with those whose roentgenograms were normal showed no significant variation. In other words, it was not possible to correlate x-ray changes with vitamin levels. Since changes in the small intestine pattern have been attributed to a thiamin deficiency, it is significant that the thiamin levels were essentially the same in the patients classified as having a B-complex deficiency, regardless of the presence or absence of roentgen changes. Furthermore, there was no correlation between the x-ray findings and the presence or absence of a peripheral neuritis. The authors conclude that minor changes in the small intestine pattern should be interpreted with caution.

Roentgenograms are reproduced, showing the normal intestinal pattern and mild, moderate, and severe changes.

A Case of Sprue Syndrome. James Isbister. M. J. Australia 1: 371-374, April 14, 1945.

A case of sprue is reported. The diagnosis was based on (a) general asthenia and emaciation, (b) ulceration of the mouth, (c) fatty diarrhea, (d) macrocytic anemia, (e) "flat" curve result of the oral glucose tolerance test, (f) "deficiency pattern" of the small intestine, (g) course of the disease. The syndrome is discussed with special reference to the roentgen appearance of the small intestine.

Malignant Tumours of the Small Intestine. A Review of the Literature and Report of 21 Cases. Kenneth Fraser. Brit. J. Surg. 32: 479-491, April 1945.

The author reports 21 new cases of malignant tumors of the small intestine, including 4 adenocarcinomas and 3 sarcomas of the jejunum, and 7 adenocarcinomas and 6 sarcomas of the ileum. In one case, an adenocarcinoma, the exact location was not stated.

Weight loss and anemia are important clinical features of malignant growths in the small bowel. Sar-

comas are more frequently palpable than carcinomas because of their distal location and larger size. Gastrointestinal symptoms take the form of recurring attacks of intestinal obstruction, with nausea and vomiting.

X-ray examination is of great help in diagnosis. In those cases where there is an element of obstruction, the method of choice is to pass the Miller-Abbott tube up to the point of obstruction and then instill a thin barium suspension to outline the tumor. It can without obstruction an aqueous suspension of barium sulfate by mouth may be used, films being taken at frequent intervals. The cardinal features in the early cases, according to Åkerlund (Acta chir. Scandinav. 71: 1, 1932) are obliteration of normal rugae; stiffness of the affected portion of the intestine, which is swelling and tender to pressure; filling defect; peduncles forming pseudo-diverticula.

The author reports 8 cases in detail, with illustrations of pathological specimens and photomicrographs. In the first case a barium meal study showed a normal stomach and duodenum; operation revealed an annular carcinoma in the proximal jejunum completely occluding the lumen and invading the mesentery. In this case a palpable tender mass was present. In the second case there was a long history of indigestion with an attack of acute abdominal pain immediately before admission. Operation revealed a large carcinoma of the jejunum with leakage, resulting in a fatal peritonitis. In the third case there was a palpable tumor to the left of the umbilicus and operation revealed an intussusception of the small bowel due to an annular carcinoma producing almost complete occlusion.

The tumor in the fourth case was a mucoid adenocarcinoma in the ileum, about 18 inches from the ileocecal valve, annular in character and causing chronic obstruction. The fifth patient had a small annular carcinoma, with almost complete obstruction and marked dilatation of the bowel proximal to the tumor. In the sixth case, also, an annular tumor in the ileum caused a high degree of obstruction; the pathological report was reticulum-cell sarcoma growing from lymphoid tissue. The seventh patient suffered acute colicky pain, and peristalsis was visible below the umbilicus, from right to left. Operation revealed distention of both the small and large bowel and an annular tumor involving the terminal ileum, which proved to be a reticulum-cell sarcoma. The eighth patient gave a history of abdominal discomfort and vomiting of only a week's duration. There was a tender movable mass in the left hypochondrium. The patient was too ill for operation and died two days after admission. Postmortem examination revealed a reticular-cell sarcoma of the jejunum with perforation and purulent peritonitis.

The prognosis in malignant tumors of the small bowel is bad because of the degree of obstruction usually present when the patient is first seen by the surgeon and also because of the high frequency of metastasis. The treatment of choice is resection of the affected loop of bowel along with a wedge of related mesentery and contained lymphatics. Postoperative or palliative x-ray therapy is recommended by many writers.

MAX CLIMAN, M.D.

Congenital Malformations of the Anus and Rectum: A Clinical Study. Eugene T. Dmytryk. Arch. Surg. 50: 253-257, May 1945.

Congenital malformations of the rectum and anus are rare, occurring once in 5,000 to 10,000 births. They

are four types: (1) incomplete rupture of the anal membrane, or stenosis 1 to 4 cm. above the anus; (2) imperforate anus with obstruction due to a persistent membrane; (3) failure of formation of the anal pouch, with blind termination of the rectal pouch in or above the pelvis; (4) a normal anal pouch with either a membranous obstruction or separation between the anal and rectal pouches. The author reports 5 cases of type 1 and 10 cases of type 3. Five patients also had fistulas between the rectum and the genito-urinary tract or perineum.

Röntgen study in the type 1 cases usually showed dilatation of the colon proximal to the stricture. In some of the type 3 cases, studies were made with barium injected into the distal loop following colostomy. Wangenstein and Rice (Ann. Surg. 92: 77, 1930) advocate plain films of the abdomen with the child inverted and an opaque marker in the anal region; the colonic gas rises in the distal loop and acts as a contrast medium.

Treatment in the type 1 cases was by dilatation or, when necessary, by plastic operation. In type 2 cruciate incision of the membrane is recommended. Types 3 and 4 require a plastic operation, preceded by colostomy in those patients with obstruction. Of the 5 type 1 patients, all survived. Seven of the 10 type 3 patients died, including all (5 patients) who showed obstruction on admission. The author considers this mortality excessive.

LEWIS G. JACOBS, M.D.

Calcified Hemangiomas of the Liver. Melvin Aspray. Am. J. Roentgenol. 53: 446-453, May 1945.

Hemangiomas of the liver are among the most common benign tumors of the viscera. They seldom become calcified. A case is described in which extensive circumscribed calcified shadows in the region of the liver were present. Streaks of calcification seemed to radiate out from the center of the mass. This is similar to the type of radiating calcified spicules seen in hemangioma of flat bones and may prove to be characteristic of calcification in visceral hemangiomas.

In the differential diagnosis of calcification in the liver, gumma, hydatid cyst, tuberculoma, amebic abscess, intrahepatic calculi, calcified primary and metastatic carcinoma, and calcified subphrenic abscess have been considered.

The treatment of hemangioma is either by surgery, radiation therapy, or a combination of these two.

A considerable bibliography is appended.

CLARENCE E. WEAVER, M.D.

Cholangiograms in Intrahepatic Processes. Paul Rudström. Acta radiol. 25: 756-762, Nov. 21, 1944. (In German.)

The author reports two cases, one of hepatic tumor and one of cholangitis, to illustrate the value of operative cholangiography.

LEWIS G. JACOBS, M.D.

Gall Stone Ileus. Gordon McHardy and Donovan C. Brown. New Orleans M. & S. J. 97: 501-503, May 1945.

A case is presented of gallstone ileus in which a roentgen preoperative diagnosis permitted surgical relief of obstruction. A postoperative film revealed a persistent cholecystoduodenal fistula as the source of an ascending cholangitis. Cholecystectomy and closure of the fistula were carried out and the patient became symptom-free.

THE MUSCULOSKELETAL SYSTEM

Plasmocytoma of Bone. William Tennent. Brit. J. Surg. 32: 471-476, April 1945.

Plasmocytoma of bone arises in the marrow of the flat bones, long bones, or vertebrae. The favorite sites are the ilium and the proximal ends of the femur and humerus. These tumors have been called reticulosarcoma, plasmoma, and solitary myeloma. The patient is usually a middle-aged man, complaining of a constant dull aching pain in the region of the hip or shoulder with localized swelling and no restriction of movement. X-ray examination reveals an isolated bone tumor of central origin. Surgical removal and/or radiotherapy are followed by a permanent cure or the late onset of multiple myelomatosis. The author has found 49 cases reported to date and adds a case of his own.

The patient, a man of 50, was found, during the course of a lobar pneumonia, to have a mass deep in the right iliac fossa. Intravenous pyelography, done to exclude urinary tract disease, revealed a large area of destruction in the right ilium, shown by biopsy to be a plasmocytoma. No additional foci were found in the remainder of the skeleton. Though the patient gave a history of pain in the hip of some three years' duration, he refused treatment. Two years later he was seen suffering from general weakness, loss of weight, and dyspnea. X-ray examination of the skeleton now revealed multiple myelomatosis involving the left femur, cranial vault, ribs, and both humeri. Bence-Jones proteose was present in the urine. Death ensued a few weeks later.

This case raises the question whether the removal of the original lesion in the ilium would have prevented the onset of multiple myelomatosis. It is also a matter for speculation whether multiple myeloma is a systemic disease of the bone marrow or a terminal stage of multiple metastases from a primary plasmocytoma.

The radiological appearance of plasmocytoma of bone depends on the site of the tumor. In a flat bone like the ilium the lesion is osteolytic, with no sclerosis or new bone formation. The cortex is thinned but not broken, and coarse trabeculae cross the medullary cavity in a vertical direction. The radiological diagnosis is often giant-cell osteoclastoma. In a long bone the lesion does not occur at the end of the shaft as does osteoclastoma; extension occurs in the long axis of the bone with complete absence of periosteal or osteogenic reaction. In the differential diagnosis simple bone cyst, Ewing's tumor, endosteal sarcoma, osteitis fibrosa cystica, and metastatic carcinoma must be considered. It is worth noting that if in a case of plasmocytoma a multiple myelomatosis does subsequently develop, the multiple bone lesions bear no resemblance to the primary plasmocytoma, but appear as small, circular, sharply defined areas of rarefaction within the medullary cavity.

Sternal puncture is of value while the growth is localized. True plasma cells or cells identical with the tumor cells may be found in excess in the sternal marrow. Blood chemistry is normal and the Bence-Jones test is negative in the presence of a localized plasmocytoma. With the onset of multiple myelomatosis the characteristic changes in the blood appear. The serum calcium may be elevated and, if there is renal damage, phosphorus retention will occur.

The histologic diagnosis is not always positive, due to the fact that this tumor may occur in a variety of

related types. Some pathologists distinguish between plasmocytoma and plasmosarcoma. Others agree that there is a slowly growing type composed of true mature plasma cells and a more rapidly growing anaplastic type resembling a reticulosarcoma or lymphosarcoma.

The reported cases were treated variously, by amputation, curettage, and radiation, but nothing is to be learned as to the relative merits of these methods, owing to lack of adequate follow-up. In general, it may be said that the prognosis is less favorable than in osteoclastoma and considerably more favorable than in osteogenic sarcoma, with the possibility of an untreated patient (as here reported) surviving for five years or longer.

MAX CLIMAN, M.D.

Intervertebral Disc Injury: Analysis from an Industrial Standpoint. Henry C. Marble and William A. Bishop. *J. Indust. Hyg. & Toxicol.* 27: 103-106, April 1945.

In a series of 496 industrial cases in which herniation of the intervertebral disk was suspected, 92 patients were operated upon, while the remainder received other therapy. From this series all cases with complications, fractures, or other lesions which might confuse the picture, were eliminated. The 92 cases are analyzed from the standpoint of cost, disability, cause, and diagnostic criteria.

Thirty-four men were able to resume their occupations at approximately the same rate of pay within six months; 9 patients returned to work within a year; in 49 the disability lasted more than a year. The total cost (for medical care and compensation) of a poor result is more than six times the cost of a favorable end result; the medical cost is over three times what is paid out when a worker gets well within six months and over ten times that of a quick recovery.

All of these cases were seen by various consultants. A preoperative diagnosis of ruptured disk was made neurologically in 73 cases and was confirmed at operation in 53. The orthopedic surgeon was correct in his diagnosis in 44 out of 54 cases. A diagnosis based on lipiodol injection of the spinal column proved correct in 23 out of 28 cases. Air used as a contrast medium in 37 cases indicated herniation of the intervertebral disk, but among this number only 25 herniated disks were found at operation. There was a definite record of muscular atrophy in 26 patients, but at operation 9 of these were found not to have a protruded nucleus pulposus. High protein was found in the spinal fluid in 21 cases, but at operation only 16 had positive disk findings; a normal protein was found in 16 patients with herniated disks.

A discussion of intervertebral disk injury by Dr. Eric Oldberg and Dr. Paul B. Magnuson is appended. Doctor Oldberg emphasizes the importance of a trial of conservative management. He rarely undertakes operation in suspected disk injuries in patients over fifty years of age. He believes that fusion should not be done unless there is a distinct orthopedic reason for it. He does not favor the use of a contrast medium in spinal canal roentgenography, having seen definite filling defects in many cases in which no lesion was found at operation and normal films in many others in which a large ruptured disk was eventually discovered. Doctor Magnuson believes that the percentage of cures in the series reported by Marble and Bishop would probably have been much lower in less prosperous

times. They cover a five-year period (1939 to 1944) when employment was at a maximum.

Disc Lesions in Relation to Pain. A. Craig Mooney. *Brit. J. Radiol.* 18: 153-157, May 1945.

There has been a tendency in recent years to overlook the more common but less spectacular lesions of the disks which cause pain.

The intervertebral disk consists of three parts. The cartilage plates, which play an important part in disk pathology, are thin plates of hyaline cartilage limiting the vertebral bodies above and below. There is no compact bone under them. A fibrous ring forms the greater part of the disk and encloses the nucleus pulposus, which is a gelatinous mass. The nucleus, except in later life, is under pressure estimated to be about 30 lb. to the square inch. In childhood the cartilage plates dip into the bone in grooves, which are most conspicuous about the age of ten. Later, deposits of calcium appear in each groove to form a peripheral ring of ossific material which eventually form the compact bony ring of the vertebra.

Disk lesions show different characteristics at different age periods. In adolescent spines, slight expansions are often observed in the region of the nucleus pulposus, or there may be more marked hemispherical extension of the nuclear center into the vertebral body. If there is a break in the cartilage plates under this condition, pain ensues. If the fissure in the cartilage is slight, the escape of the nuclear tissue is gradual and a sclerotic barrier forms around the margin. If the fissure is large, there may be an explosive propulsion of nuclear tissue with a considerable defect. These tend to heal with replacement by bony tissue.

Epiphysitis of the Scheuermann type occurs between the ages of fourteen and seventeen. Schmorl explained this condition on the basis of gross nuclear escape, but the author believes that there is no doubt that it is an inflammatory process. The condition is more serious and requires more and longer immobilization than nuclear ruptures. Wedging of the vertebrae is apt to occur. There is sometimes active nuclear escape in the course of the disease. Careful and repeated x-ray examination should be made to rule out tuberculous infection.

The typical posterior herniations of the nucleus are primarily a disease of young adult life. A posterior situation of the nucleus may be a predisposing factor in such cases.

From about forty years on, the disk begins to lose vitality. Annular degeneration is first noticed as a narrowing of the intervertebral space. Pathologically there are shrinkage and softening of the annulus and the spreading of the nucleus toward the periphery. If the degeneration is progressive, the annulus may finally remain only as a rim of fibrocartilage. One of the most common manifestations of loss of disk vitality is the formation of spurs. In determining the relation between osteo-arthritic changes and pain, however, one must look beyond the spur formation, either for actual disk destruction or changes in the interarticular joints. To a certain extent spur formation is to be regarded as physiological.

Gross destruction and narrowing of the disks may cause subluxation of the articular joints with narrowing of the neural foramina and resulting pain.

SYDNEY J. HAWLEY, M.D.

Pantopaque Myelography: Results, Comparison of Contrast Media, and Spinal Fluid Reaction. William G. Peachler and Robert C. L. Robertson. *J. Neurosurg.* 2: 220-231, May 1945.

Pantopaque was used as the contrast medium in 300 successive myelographic examinations, with excellent results. In 150 cases operated upon for herniated nucleus pulposus, the diagnostic accuracy was 96.7 per cent. Pantopaque is comparable to lipiodol in fluoroscopy and x-ray interpretation but, unlike the latter, it is easily removed and is gradually absorbed. Reactions are extremely rare. Pantopaque is not contraindicated in the presence of inflammatory or degenerative lesions, and encystment has not been seen. The meningeal response to injection has been minimal and transient. Facts are presented to show the value of contrast media and to emphasize the possibility of error if too great reliance is placed on the clinical data and routine x-ray examination in determining the presence or absence of disk lesions.

Further Experience with Myelography with Abrodil. Sigfrid Arnell. *Acta radiol.* 25: 408-413, Nov. 21, 1944. (In German.)

Myelography with a water-soluble medium was first described by Lidström *et al.* in 1931. However, fatal accidents were reported by several authors, being apparently due to the high osmotic pressure of the contrast substance. A 20 per cent solution of Abrodil is free of this risk and leads to only transient pain in the legs and in the distributions of nerves touched by the solution. However, a preliminary intracutaneous test for sensitivity should always be made.

The patient is subjected to lumbar puncture in the sitting position and 2 c.c. of 7 per cent novocaine are injected for lumbar anesthesia. After about ten minutes (to allow development of anesthesia) 10 c.c. of 20 per cent Abrodil is injected and the required posterior and lateral projections are made. The patient is kept with the head and shoulders elevated for some hours after the examination. This contrast medium is rapidly absorbed; so rapidly that it is usually impossible to retake films if the first prove unsatisfactory. Patients who had been subjected to both Abrodil and air myelography experienced less reaction from the Abrodil. The article is illustrated with some myelograms on operatively proved cases. LEWIS G. JACOBS, M.D.

Case of Pseudarthrosis Following Fractures of the Lumbar Transverse Processes. Geoffrey Hyman. *Brit. J. Surg.* 32: 503-505, April 1945.

A man, aged 34 years, sustained a fracture of the 2d, 3d, 4th, and 5th right lumbar transverse processes. After three months of immobilization and massage he complained of constant pain in the lower back, worse on bending. X-ray examination at this time showed bony processes projecting from the adjacent borders of the transverse processes of the 2d and 3d lumbar vertebrae on the right side, with formation of a well marked joint between the new bony masses. The question of a congenital abnormality was raised and was excluded only after the original films were examined. Manipulation gave only temporary relief and it was therefore decided to excise the mass of new bone formation and the joint. At operation the joint was found to be enclosed by a capsule. A section through the pseudarthrosis showed a fibrous

band between the bone masses, which prevented union; a comparatively well organized hyaline cartilage covered the joint surfaces. MAX CLIMAN, M.D.

Progeria: Clinical, Metabolic and Pathologic Studies on a Patient. Nathan B. Talbot, Allan M. Butler, Edward L. Pratt, E. A. MacLachlan, and J. Tanneheimer. *Am. J. Dis. Child.* 69: 267-279, May 1945.

Metabolic studies on a boy with progeria were carried out during the year preceding his death from coronary thrombosis, at the age of seven and a half. The clinical picture was typical of progeria—dwarfism, loss of hair and of subcutaneous fat, and precocious arteriosclerosis. The intelligence quotient was high.

Roentgenograms revealed the following noteworthy features: The sutures of the skull were narrower than usual at the patient's age; the mandibles were unusually small, and there was under-development of the coronoid and condyloid processes; the bones of the extremities were small; the epiphyseal lines appeared definitely narrower than usual; lateral views of the spine showed an unusual degree of anterior notching; the shafts of the femurs were narrow, in contradistinction to wide femoral necks; the axis of the femoral neck was a continuation of the axis of the shaft; the pubic and ischial bones were completely and precociously united; the skeletal age, estimated from the hand and wrist, corresponded to the normal for a six-year-old boy according to Todd's standards, and most of the bones of the body appeared to be poorly mineralized. Especially notable was the lack of subcutaneous tissue. A roentgenogram of the arms taken when the patient was two years old indicated that he possessed a visible amount of subcutaneous tissue at that time while a similar film taken at the age of six and a half revealed none.

Metabolic studies showed that the patient ingested and assimilated a quantity of food adequate for the maintenance and growth of normal children of similar body weight. It appeared, however, that all the calories in the diet were used to meet the basal and intermediary requirements of energy metabolism, thus leaving no residue for growth or the accumulation of subcutaneous fat. With testosterone therapy the patient gained a greater weight of musculature, according to the data on nitrogen and potassium balance, than he gained in total body weight. This was interpreted to mean that he had burned a significant amount of stored body fat to pay for the caloric deficit incurred by building muscle. The final studies showed that the patient could be made to gain by reducing the energy output with the aid of thiouracil. The authors conclude that the hypermetabolism in this patient was not due to hyperthyroidism as it is ordinarily encountered in children. Postmortem examination revealed no explanation for the clinical characteristics or metabolic features of this condition.

Renal Rickets—A Case Report. Frank J. Borrelli and George G. Green. *Urol. & Cutan. Rev.* 49: 213-216, April 1945.

The authors' patient was an 11-year old white girl, who had been examined elsewhere at the age of ten, when extensive bone, kidney, and blood chemistry changes were already present. Roentgen examination showed demineralization with fragmentation and widening at the metaphyses of the long bones, incomplete epiphyseal development, a diffuse homogeneous thick-

ening and finely irregular fuzzy appearance of the skull, and increased condensation of the vertebral bodies. Retrograde pyelography revealed hypoplastic kidneys with a reduction in the parenchymal tissue. Hypertension was believed to be due to decreased kidney function. The non-protein nitrogen and urea nitrogen were elevated and the carbon dioxide-combining power reduced. Blood calcium was low and phosphorus high, which probably accounted for the rachitic changes.

MAURICE D. SACHS, M.D.

Osteomyelitis of the Clavicle. Tina Gray. *Brit. J. Surg.* 32: 466-467, April 1945.

A boy aged 12 complained of pain and slight swelling over the left clavicle after a fall. A fracture was suspected, but roentgen examination showed a normal bone. Two weeks later there were signs of an abscess, which was incised and drained. The roentgenogram revealed destruction of the outer third of the clavicle. After another week there was an elevation of temperature and the area over the clavicle was swollen, red, and fluctuant. The previous incision was enlarged and the entire clavicle was removed, leaving a pus-filled cavity lined with congestive granulations. Recovery was uneventful and after three weeks there was palpable formation of bone at the acromial end. After six weeks x-ray films showed beginning molding of the new clavicle, and in two months the wound was healed and there was a normal range of movement. The final films show a completely regenerated clavicle.

MAX CLIMAN, M.D.

Roentgen Demonstration of the Semilunar Cartilages of the Knee. J. W. Grossman and Howard H. Minor. *Am. J. Roentgenol.* 53: 454-465, May 1945.

By combining the injection of a small amount of air with forced abduction of the knee joint during roentgenography, the authors have been able to visualize both semilunar cartilages satisfactorily. Ten to 20 c.c. of atmospheric air, filtered through several thicknesses of sterile gauze, is slowly injected into the joint after as much fluid as possible has first been withdrawn. Devices are described for stabilizing the thigh and knee while abduction of the leg is done manually. Both compartments of the knee joint, medial and lateral, are examined with the patient prone and supine. Examinations are made in the Trendelenburg position so as to allow fluid to gravitate away from the joint space, thus preventing interference with the meniscus shadows. The air is absorbed in about five to seven days. By the technic used, all parts (anterior, lateral, and posterior horns) of the lateral and medial semilunar cartilages are visualized. In many instances the cruciate ligaments are seen. The articular cartilage over the tibia and femur is also shown.

A detailed description is given of the normal appearance of the lateral and medial semilunar cartilages. Pathological changes may be recognized by any alteration in their appearance from the normal. There are no constant pathological pictures (with the exception of bucket-handle tears with dislocation), since each case varies. Thinning and fraying may indicate degenerative changes. The bucket-handle tears of the menisci, with dislocation of the fractured portion of the cartilage into the intercondyloid notch, usually result in a fairly constant roentgen appearance. Most of these have been demonstrated in the medial meniscus.

The technic described is harmless and has not pro-

duced any untoward effects nor aggravated existing symptoms. Two important facts have been demonstrated by this method of examination of the knee: (1) the lateral meniscus is fractured more often than is generally believed, and (2) in many cases both cartilages are shown to be involved. The degree of damage of a meniscus may be visualized and this may serve as a guide to the proper therapy.

Many illustrations are given showing the normal semilunar cartilages and various types of injury as demonstrated by the method described.

CLARENCE E. WEAVER, M.D.

Pellegrini-Stieda Disease. E. James Buckley. *U. S. Nav. M. Bull.* 44: 947-951, May 1945.

Two cases of Pellegrini-Stieda disease are recorded. In each there was a history of trauma to the knee and in each the characteristic roentgen picture of crescentic calcification in the region of the adductor tubercle was obtained a few weeks subsequent to the injury.

Radioulnar Synostosis of Traumatic Origin: Report of a Case. H. G. Lee. *New England J. Med.* 232: 498-499, May 3, 1945.

This is the report of a severe injury to the forearm with fracture of both bones. Open reduction was done with good union, but ossification across the interosseous space occurred, preventing rotation. A second operation was done to remove the bridge between the two bones and the raw bone was covered with muscle. The forearm was dressed with compression and in full supination. Three years after the last operation, about 75 per cent rotation is present.

JOHN B. McANENY, M.D.

Delayed Rupture of the Extensor Pollicis Longus Tendon Following Colles's Fracture. Donald E. Coburn. *Am. J. Surg.* 68: 234-239, May 1945.

A case of delayed rupture of the extensor pollicis longus tendon following a fracture of the left wrist is reported. When first seen by the author, approximately five months after the fracture occurred, the patient complained of pain along the dorsal aspect of the left thumb and inability to extend it fully. Examination showed a typical flexion deformity of the thumb. The lateral border of the anatomical snuffbox, usually formed by the extensor pollicis tendon, was found to be missing when either voluntary or passive attempts were made to extend the thumb. There was no impairment of sensation. Faradic stimulation over the extensor pollicis longus muscle failed to produce extension of the thumb. On palpation of the dorsal aspect of the wrist, in the region of the groove usually occupied by the extensor pollicis longus tendon, there was considerable thickening of the subcutaneous tissue but no definite area of tenderness. X-ray films showed slight forward angulation of the lower end of the radius with a small elevated rounded lip of bone on its dorsal aspect along the site of the previous fracture. The articular surfaces of the joint were smooth. There was no evidence of any abnormal bony prominences. A review of the films taken at the time of fracture showed that it was not a typical Colles's fracture, as had been believed, but more of a reverse Colles's or so-called Smith type, and there was a definite prominent ridge of bone on the posterior aspect of the proximal fragment at the site of fracture.

Good functional and anatomical results were obtained in this case by operative repair, using a tendon transplant from the extensor carpi radialis longus. The author considers the use of an unpadded plaster cast together with early active motion, as advised in Bohler's technic, a possible etiological factor in rupture of a tendon. In the case reported, no splint was applied.

Anomalous Fusion of the Scaphoid and the Greater Multangular Bone. M. G. Henry. *Arch. Surg.* 50: 240-241, May 1945.

Congenital fusion of the carpal or tarsal bones is a rare anomaly. It may occur independently but it is usually associated with synostosis of some of the interphalangeal joints. Unlike the other carpal bones, the scaphoid and greater multangular begin to ossify in the same year of life (the sixth), and this embryonic similarity suggests that they might more often be involved in such an anomaly. Cushing has reported familial transmission of such fusion as a non-sex-linked mendelian dominant. An illustrative case showing congenital fusion of the scaphoid and greater multangular, with a concomitant traumatic fracture of the scaphoid, is briefly reported.

LEWIS G. JACOBS, M.D.

Abnormality of the Calcaneus as a Cause of Painful Heel. Its Diagnosis and Operative Treatment. A. Fowler and J. F. Philip. *Brit. J. Surg.* 32: 494-498, April 1945.

The authors have frequently observed painful swelling on the posterior aspect of the heel immediately proximal to the insertion of the tendo Achillis. All such patients fall into one of two categories. In the first group a definite bursa lying superficial to the tendo Achillis is excisable and thereafter no recurrence of the condition is seen. In the second group no actual bursa is excisable; the thickened tissue superficial to the tendon appears to consist of a chronic inflammatory reaction of the skin and subcutaneous tissues, and a recrudescence of the syndrome is invariable. Lateral roentgenograms of recurrent cases show a peculiarly shaped os calcis with a prow-like projection underlying the affected area, but cases with a demonstrable bursa superficial to the tendo Achillis do not show this abnormality.

In view of these observations, the authors undertook a study of anatomical variations in the os calcis. In a series of 45 adult bones in the dry state, measurements between fixed points were fairly constant. The most significant variation occurred in the angle formed between the posterior and inferior surfaces of the os calcis. This angle was found to vary between 44 and 69 degrees. Diminution of the angle was of no importance, but in the cases showing structural changes in the soft tissues covering the bursal area, the angle was in the region of 75 degrees or over. The increased projection of the bursal area which accounts for the increase in the angle comes to bear on the tendon above its insertion, as at this point the tendon cannot in any way be relieved from pressure. Secondary changes occur in the bone, the tendon, and overlying tissues. The operative technic for removal of the projecting portion of bone, including the bursa, is described.

MAX CLIMAN, M.D.

Joint Disease Associated with Acromegaly. H. Waite, G. A. Bennett, and W. Bauer. *Am. J. M. Sc.* 209: 671-687, May 1945.

Complete pathologic and roentgenologic studies were made of the bones of a 58-year-old white male who had pronounced acromegalic features and skeletal changes. The vertebral column showed gross, microscopic, and radiologic alterations, most of which were consistent with degenerative joint disease such as is seen in elderly non-acromegalic individuals, with three exceptions: The hypertrophic spurring at the intervertebral margins was unusually marked, the transverse diameters of D11 and D12 were slightly greater than those of L1 and L2, and there was complete and extensive bony union between D6 and D7 associated with exceedingly severe degeneration of the intervening disk. Whether these changes were incidental or specifically related to acromegaly could not be determined.

According to Erdheim (*Virchows Arch. f. path. Anat.* 281: 197, 1931), the acromegalic spine is distinguished by additional growth of the vertebral bodies and intervertebral disks. The newly formed bone, which occurs mostly on the anterior and lateral aspects, is demarcated, especially on the roentgenogram, by irregular arrangement and deficient calcification of the trabeculae. The new cortex is abnormally wide, and the increased transverse diameter of the vertebral body may give the mistaken impression of reduced height. In purely degenerative disease of the spine, marginal exostoses develop in response to degeneration of the disks and therefore vary in location and degree, while in acromegaly they are more uniformly distributed, since they are independent of disk degeneration.

The lesions of the peripheral joint surfaces were not distinctive. The earliest histologic changes in senescent arthropathy are swelling and fibrillation of the matrix of the superficial hyaline covering, leading to its erosion and subsequent alterations in joint margins, subchondral bone, and synovia. In acromegaly the earliest changes are hyperplasia and hypertrophy of the columnar zone of chondrocytes associated with an increase in matrix. Later changes similar to those of senescent arthropathy occur, so that the two conditions can be distinguished in the incipient stages only.

The changes seen in the ribs were unusual. There were marked and irregular hyperplasia and hypertrophy of the chondrocytes and an increase in matrix in the middle cortical portions of the cartilaginous rib; this is responsible for the formation of the acromegalic rosary of the rib seen clinically and roentgenographically. There was also a progressive endochondral ossification at the cartilage bone border, leading to an abnormal expansion of the thorax, long known as one of the striking characteristics of acromegaly.

In many respects, especially where marked changes have occurred, the histologic features closely resembled those of severe degenerative joint disease. In some sites evidence indicates a reactivation of cartilage growth and enhanced endochondral ossification, unphysiologic at the patient's age, and perhaps the result of a specific hormonal stimulus.

BENJAMIN COLEMAN, M.D.

Roentgenological Changes in Lead Poisoning in Children. Stig Radner. *Acta radiol.* 25: 719-726, Nov. 21, 1944. (In German.)

Lead poisoning in children produces principally neurological and gastro-intestinal symptoms. Both

clinical and laboratory findings are often indefinite. The roentgenologic changes in the bones (the "lead line") are quite constant but are not pathognomonic. A similar appearance may result from rickets, especially after overdosing with vitamin D, from syphilis, from the early changes of marble bones, from phosphorus poisoning, and from bismuth poisoning.

LEWIS G. JACOBS, M.D.

GYNECOLOGY AND OBSTETRICS

"The Krukenberg Tumors." The Roentgen and Gastroenterological Aspects of Secondary Ovarian Carcinoma. Robert M. Lowman and Samuel D. Kushlan. *Gastroenterology* 4: 305-322, April 1945.

Eight cases of Krukenberg tumor are presented, with special emphasis on the gastro-enterologic and roentgen aspects. A clear-cut history of a gastro-intestinal disturbance was obtained in 5 cases. Five patients had bilateral ovarian involvement, while in 3 only the right ovary was involved. In 2 cases the diagnosis of the primary site of the tumor was made, but the ovarian involvement was not recognized at operation. In the remaining 6 patients, the secondary lesion was recognized first.

The cases are divided into two groups, one presenting symptoms indicative of pelvic disease and the other with symptoms pointing to a lesion in the gastro-intestinal tract. In the first group of patients, clinical and surgical investigations were directed to the pelvic area. These cases illustrate the importance of a routine preoperative gastro-intestinal survey in every patient suspected of having a carcinoma of the ovary, to rule out the possibility of a primary tumor of the digestive tract. Although gastro-intestinal symptoms occur in association with pelvic disease, it is not safe to assume that this is a reflex mechanism without roentgen studies of the digestive tract.

Careful pelvic examination in any female patient with gastro-intestinal symptoms is also important. During exploration of the abdomen for gastric cancer, the possibility of ovarian metastases should be investigated.

Ascites was recorded in 4 cases. Roentgenographically, a diffuse haziness of the abdomen, obliteration of the psoas outlines and subperitoneal fat may be found associated with abdominal ascites. The gas-filled loops of small intestine appear to be floating free in the abdomen in the scout films, and the diaphragm is elevated.

Roentgenograms of the gastro-intestinal tract in either primary gastric or ovarian cancer should be studied for evidence of involvement of the small bowel. In 6 of the 8 cases in this series, generalized peritoneal carcinomatosis was found at operation or autopsy. Roentgen changes in the small intestine due to peritoneal carcinomatosis consist of (1) alteration of the mucosal pattern and (2) motility changes. The authors believe that the "irritation pattern" usually associated with peritoneal carcinomatosis is distinguished by (1) segmentation, (2) hypomotility, (3) irregular contours, and (4) feathering or fraying of the bowel margins suggestive of mucosal ulceration but due solely to serosal involvement. Less frequently, extreme irritability, abnormal segmentation, and hypermotility may be observed. In other cases, the loops of small bowel show various degrees of dilatation associated with multiple

fluid levels in the erect position. It is possible that carcinomatous nodules in the mesentery and on the serosal surface of the bowel can produce areas of localized small intestinal obstruction and hypomotility. Roentgenograms in 4 cases are reproduced.

Studies in X-Ray Pelvimetry: An Evaluation of Pelvic Radiography with a Plea for Simplicity. O. S. Heyn. *J. Obst. & Gynaec. Brit. Emp.* 52: 148-173, April 1945.

The author reports a study in which Nisholm's formula for determining the area of the pelvic brim and outlet (*J. Obst. & Gynaec. Brit. Emp.* 45: 939, 1938) was applied to a series of dry pelvises. Diophragm tracings were made of the pelvic brim and the outlet, and the calculated area was compared with the true area as determined by a planimeter. Calculations of the area of the pelvic brim, in 60 instances, showed an average error of 8.5 per cent, the calculated area in all cases being less than the true area. The main source of error was found to be the sacral promontory. When the tracings were reconstructed, disregarding the encroachment of the promontory, the calculated and planimeter areas were in close correspondence, *i.e.*, within an error limit of 5 per cent.

The area of the plane of the outlet was determined in 20 pelvises, including some with pronounced contraction. In 10 instances the calculated area exceeded and in 10 it was less than the true area. With 3 exceptions, the error was less than 10 per cent.

Having determined the limits of error, the author proceeds to a discussion of the measurements to be derived from the roentgen film. The conjugate and transverse diameters at the brim are measured and corrected according to their known height above the film and from them the area and brim index are calculated. The determination of the two outlet axes was found to be more difficult. Various methods of measuring the distance between the ischial spines are considered. The author's method makes use of the fact that when the pelvis is so placed on the table that the brim is horizontal, the ischial spines are at a fairly constant height—about 3 cm. from the table top. The horizontal position has the added advantage that the ischial spines are invariably visible on a good film, not being overshadowed as in some positions. X-ray measurement of the pubosacral diameter was not satisfactory, and clinical measurement is recommended. By subtracting 1 cm. from the clinical measurement, the true diameter is obtained.

The fifth lumbar vertebra serves as a surface marking for determining the position of the pelvic brim. With the brim horizontal, the fifth lumbar spine is at the level of the conjugata vera. With the patient in a semirecumbent position, with the back arched so as to produce a moderate lumbar lordosis, the brim is horizontal and it is possible to avoid irradiation of the upper half of the abdomen during the first half of pregnancy.

The author's procedure, which he recommends for its simplicity, calls for a single anteroposterior view. From this the area of the inlet and outlet and the brim index are obtained. No more than this is required for practical purposes except to palpate the pubic arch for height, width, and the height of the symphysis pubis. If the arch is suspiciously narrow, a film giving accurate measurements is simply obtained. A lateral view of the pelvis is required only in special cases.

The author was unable to demonstrate roentgenographically the greatest transverse diameter of the

pelvic brim, and this he believes cannot be accomplished by any method. This inlet seen on the film represents a level near to that of the pelvic cavity. The iliac portion of the iliopectineal line cannot be seen, and its anterior portion is usually simulated by other anatomic features. It is, therefore, impossible by radiographic means to obtain measurements of the superior strait, *i.e.*, excluding the conjugata vera, on the lateral film. The estimation of the area and the pelvic brim index for this level are discussed and a solution is offered.

The paper closes with a survey of various methods of x-ray pelvimetry and its present status.

THE GENITO-URINARY TRACT

Excretion Urography, Its Value in the Diagnosis of Renal Diseases. Harry A. Olin. *Urol. & Cutan. Rev.* 49: 220-223, April 1945.

Excretion urography was first introduced in 1929. Routine examination includes a scout film before the injection of the dye, which is preferably done in the morning after abstention from food and drink for eight hours, and films taken at five-, fifteen-, thirty-, and sixty-minute intervals after injection. If excretion is delayed, films are taken at later intervals.

Excretion urography is indicated (1) in conditions precluding cystoscopy and ureteral catheterization, as ureteral or urethral strictures, fistulae, certain anomalies, etc.; (2) when instrumentation is difficult, as in aged and debilitated patients in whom anesthesia is impossible, in injury to the genito-urinary tract, and in children; (3) in lower urinary tract infections and infections of the adnexa; (4) following nephrectomy to determine the condition of the opposite kidney; (5) following kidney and pelvic operations to determine the presence or extent of ureteral injury; (6) in pregnancy; (7) for the differential diagnosis of abdominal tumors and of gallstones and renal calculi; (8) in malposition and anatomic anomalies of the kidney and ureters; (9) in renal infections; (10) in certain renal tumors; (11) to determine urinary stasis; (12) to determine the degree of urinary obstruction, as from calculus. Contraindications are: liver disorders, nephritis, exudative diathesis, and uremia. Special caution should be exercised in the use of contrast media in the presence of hyperthyroidism.

The many pathological renal and extrarenal lesions first determined by urography are discussed. Full cooperation between the radiologist and urologist is essential for a correct diagnosis.

MAURICE D. SACHS, M.D.

Subcutaneous Urography. Jacob H. Vastine, 2d, and Mary Frances Vastine. *Urol. & Cutan. Rev.* 49: 199-201, April 1945.

The authors made a study of subcutaneous urography in 20 children, in whom intravenous urography was also done. No difference was found in the diagnostic value of the two procedures.

The subcutaneous method was first introduced in 1931 and is of particular advantage in children or adults with inaccessible veins. After a 12-hour period of dehydration the patient is tested for iodine sensitivity. A dry meal is given just before injection of the dye (it is believed that this procedure reduces the amount of

intestinal gas), and a scout film is taken. After the skin is prepared, a small wheal is raised with novocain in the region of the angle of each scapula, and 50 c.c. of contrast solution (prepared by adding 80 c.c. of normal saline to 35 per cent diodrast or 40 per cent "diodrast compound") is injected into each area. Films are taken at ten-minute intervals for fifty minutes. Care should be taken not to inject the dye over the kidney area, thereby obscuring renal details.

The authors are of the opinion that subcutaneous pyelogram studies are a satisfactory substitute for intravenous urography and are indicated in children or adults if the veins are difficult to find.

The literature on subcutaneous and intramuscular pyelography is reviewed. MAURICE D. SACHS, M.D.

Renal Lithiasis and Its Treatment. A. Hyman. *Surg. Clin. North America* 25: 307-324, April 1945.

After a discussion of the etiologic concepts and the clinical aspects of nephrolithiasis, the writer considers briefly the urological investigation. This entails a careful urinalysis, radiography, pyelography, and cystoscopy. Approximately 10 to 15 per cent of renal calculi fail to show up on the plain films, and for more complete information, intravenous urography is essential. Numerous roentgenograms illustrate this part of the paper.

Following a complete urological work-up one is in a position to determine whether the treatment should be medical or surgical. Operation may be contraindicated in certain cases of bilateral staghorn calculus, recurrences following surgery, and cystine stones. Intervention is indicated, first, from the subjective point of view, if the calculus produces attacks of pain or colic and is of such a size that its spontaneous passage is questionable. Any calculus that causes infection and obstruction should definitely be removed. The author also considers a silent calculus a potential source of trouble and advocates removal.

Immediately prior to operation for multiple pelvic and caliceal stones, a roentgenogram should be taken to be certain a calculus has not migrated into the ureter or been extruded from the pelvis into a calix or *vice versa*.

Facilities should be on hand to take roentgenograms of the surgically exposed kidney. (For this purpose the author uses a simple dental film.) In a series of 85 operative x-ray control examinations, stone or stone fragments, which could not be palpated and were not demonstrable on the routine roentgenogram, were located in 29 cases, or 34 per cent. The extended use of this method would lower the percentage of so-called true recurrences, for undoubtedly many of these are actually residual calculi.

ELLWOOD W. GODFREY, M.D.

Inflammatory Lesions of the Kidneys. Lewis J. Friedman and Paul S. Friedman. *Urol. & Cutan. Rev.* 49: 201-204, April 1945.

Early roentgen recognition of renal inflammations is of prime importance if prompt specific therapeutic measures are to be instituted. Excretory urograms, including a scout film, are routine, to be followed by retrograde studies if there is any doubt as to the diagnosis.

Kidney inflammations are classified as follows: (1) acute pyelitis and pyelonephritis; (2) chronic pyelo-

nephritis and pyonephrosis; (3) tuberculous pyelonephritis; (4) carbuncle of the kidney; (5) perinephric abscess. The roentgen criteria are as follows:

(1) *Acute Pyelonephritis*: Poor filling of the pelvis and involved calices, presumably due to irritability, and blunting of the minor calices due to destruction of the renal papillae.

(2) *Chronic Pyelonephritis*: Diminished function of the involved kidney; progressive blunting of the apical portion of the minor calices and broadening of their bases; dilatation of the ureter. In the end stage, there is poor renal function with marked deformity of the calices, pelves, and ureter. When a calculus is present, the kidney is large, with poor function, and the renal pelvis and proximal ureter are dilated.

(3) *Tuberculous Pyelonephritis*: In the early stages, irregularity and distortion of a calix; with more advanced disease, bulbous deformity of a calix, projecting into the renal parenchyma; with development of a true pyonephrosis, renal enlargement, deformity of the calices, pelvic and ureteral strictures.

(4) *Renal Carbuncle*: Small carbuncles produce no roentgen findings. Larger carbuncles show compression of calices and widening of intercaliceal angle.

(5) *Perinephric Abscess*: Obliteration of the outline of the psoas muscle; scoliosis of the lumbar spine with concavity toward the involved side; elevation or restricted mobility of hemidiaphragm; kidney and ureter rotated and displaced anteriorly; lack of renal mobility in inspiration and expiration.

The authors emphasize that only a careful evaluation of the clinical and roentgen findings will result in a correct diagnosis. MAURICE D. SACHS, M.D.

Traumatic Infarction of the Kidney. W. K. Rexford and Paul J. Connolly. *Am. J. Surg.* 68: 250-253, May 1945.

A case of traumatic infarction of the kidney in a 27-year-old male is reported. Following his injury, the patient complained of pain all over the body, but particularly about the thorax, upper abdomen, and shoulders. Films of the dorsolumbosacral spine, pelvis, and thoracic cage revealed no fracture. Physical examination showed exquisite tenderness in the mid-epigastrium and in the left upper two-thirds of the abdomen, with some splinting of the left side. Urinalysis immediately upon hospital admission was normal except for a trace of albumin. A second specimen showed a few red cells but subsequent examinations did not confirm this finding, although two days later the albumin increased to four plus. The temperature rose to 101° F. daily. A flat plate of the abdomen the day after admission revealed a diminution in the usual gas shadows of the left abdomen, particularly in the left upper quadrant. It was impossible to state, however, that this could be considered definite evidence of retroperitoneal or intra-abdominal collection of fluid or hemorrhage. The psoas shadow on the left was less distinct than on the right, and the outline of the soft-tissue structures in the left upper quadrant was not so definite as normally. The patient continued to have thoracic and epigastric pain, with nausea and vomiting. An intravenous pyelogram, on the third day, showed the right kidney to be entirely normal, but no dye was excreted from the left. The following day cystoscopy was done and the left ureter was catheterized. No urine was obtained, and the return flow of injected

water was reddish in color. Intravenous indigo carmine appeared on the right side in six minutes, but none from the left side in ten minutes. In retrograde pyelograms the kidney outline was not differentiated from the surrounding structures but the findings were otherwise normal. Cystoscopy, a week later, showed no signs of indigo carmine from the left ureter in thirty-five minutes, although it appeared from the right in seven minutes. A nephrectomy was performed. Section of the kidney revealed three yellowish-gray irregular areas representing soft infarcts, with a destruction of 50 per cent of the renal tissue.

The authors conclude that intravenous pyelograms should be made early in any case in which rupture is suspected. If these are unsatisfactory in any detail, retrograde studies are indicated. It is believed that the dangers of retrograde pyelography are far outweighed by the information that they give.

Anomalies of Ureters and Kidneys as Observed by the Radiologist. Bernard H. Nichols. *Urol. & Cutan. Rev.* 49: 265-268, May 1945.

According to the generally accepted theory of the embryonic development of the urinary tract, the renal buds develop from the wolffian ducts and ascend to divide into upper and lower segments. During the ascent the kidneys rotate and the renal pelves are arrested in a medial position. Vascularization is believed to occur at the height of the renal ascent, which is completed in two months. Most urologic anomalies are primarily embryonic with subsequent abnormal development.

The development of the ureters is separate from that of the kidneys. Premature bud separation or extension of the division of the kidney into the ureteral portion may produce ureteral duplication. The ureteral orifices may be outside the bladder or the lower end of the ureter may be duplicated. Deformities may also result from strictures, kinks, or so-called congenital valves. Herniation into the bladder of mucosal duplication may produce a ureterocele. Ureteral anomalies are of significance as predisposing to renal disease.

The common anomalies of the kidney are: (1) solitary kidney; (2) supernumerary kidneys; (3) fused kidney with all its variations; (4) ectopic kidney; (5) polycystic kidneys; (6) solitary renal cyst; (7) anomalous renal vessels and congenital bands obstructing the upper ureter. Each of these the author discusses briefly, emphasizing the variations that may occur and stressing the value of excretory urography in all suspected cases.

Illustrations are included to show various anomalies. MAURICE D. SACHS, M.D.

Duplication of Right Kidney Pelvis and Ureter with Extravesical Ureteral Opening. Russell J. Moc. *Am. J. Obst. & Gynec.* 49: 641-646, May 1945.

The author states that among the approximately 300 recorded cases of accessory ureters with extravesical openings, the frequency of occurrence in women is twice that in men. In females, the ectopic ureter opens distal to the vesical sphincter and produces dribbling. In males, it opens proximal to the sphincter and produces no symptoms.

Embryologically, the accessory ureter represents a regressive variation. It arises cranial to the normal ureteral bud, which has its anlage from the caudal end of the wolffian duct. The normal ureteral bud, being

more caudad, reaches the bladder first. The upper accessory ureter is carried caudalward and, because of rotation and growth of tissue between the ureteral opening and the orifice of the wolffian duct, it often becomes implanted below the bladder sphincter.

The diagnosis is based on a history of dribbling and incontinence of urine in the presence of normal bladder function. This is confirmed by a demonstration of multiple pelves on one side, by intravenous pyelography.

The treatment depends on the size of the segment of kidney drained by the ectopic ureter. Heminephrectomy is the procedure of choice. Attempts to implant the ureter into the bladder are not advised, because the accessory ureter and kidney pelvis are usually infected. The author reports one case and includes photographs of the diagnostic films. STANLEY H. MACHT, M.D.

Renal Dystopia. Leon Solis-Cohen and Samuel Levine. *Urol. & Cutan. Rev.* 49: 203-213, April 1945.

The authors consider the various conditions which may result in renal dystopia, or malposition, describing the roentgen findings and illustrating these with roentgenograms. For study of the urinary or renal tract, films in the recumbent, upright, lateral, and often in tangential planes, are essential. It is also important to visualize the leaves of the diaphragm and pulmonary bases. Localized films with the kidney field in the center of the film are obligatory in order to avoid the fading out of images at the upper and lower borders of films.

Renal dystopia may be congenital or acquired. Increased mobility of the kidney is favored by absence of peritoneal support, diminution—through absence of peritoneal fat—in the tension of the peritoneum and perirenal fascia, trauma producing stretching of the peritoneum and renal vessels, etc. Pull and push exerted by other abdominal viscera may also displace the kidneys.

In congenital dystopia the ureter is short. The ectopic kidney may be on its own or the opposite side, and may produce a small and distorted roentgen image. If a crossed ectopia is present, there is likely to be a fusion of the kidneys. Ectopic kidney is to be differentiated from a movable kidney. The latter is always on the normal side and has a ureter of normal length, though it may be tortuous and kinked.

The kidney pelvis and calices may be dilated and displaced, in the presence of aneurysm of the renal arteries, by pressure of the aneurysmal sac. A ring-like calcified shadow with a relatively dense periphery is considered a characteristic roentgen sign.

A solitary cyst may displace the calices and pelvis, molding them to present a curved distorted border localized to the site of the cyst. Roentgen examination reveals this crescentic outline and an extension of either polar shadow merging with the cystic contour. Larger cysts may cause upward or downward displacement of the kidney. Neither solitary cysts or the cysts of polycystic kidney communicate with the renal pelvis. Polycystic kidneys may encroach upon the major calices, while the minor calices retain their normal form. The pelvis is elongated and narrowed by pressure. In advanced polycystic disease, there is considerable medial displacement of the renal pelves, with an accentuated convexity at the uteropelvic junction and proximal portion of the ureter.

Tumors of the lower pole of the kidney may produce upper displacement and flattening of the renal pelvis;

the calices may be either markedly deformed or present a crescentic shape. Both intrarenal and extrarenal tumors may displace the renal pelvis in any diameter; the former are more often accompanied by pelvic deformity, while in the latter the kidney pelvis may be normal in contour. Benign tumors of the kidney usually produce a displacement of the kidney pelvis with minimal changes in the calices. Alveolar carcinoma produces major changes and considerable distortion in the kidney pelvis, while papillary neoplasms result in major deformity of the calices and minimal pelvic alterations.

Renal torsion may result from a perinephritic retroperitoneal tumor, perinephric abscess, or perirenal hematoma.

MAURICE D. SACHS, M.D.

Renal Ectopia. A Study of Twenty-Three Cases. Earl F. Nation. *Am. J. Surg.* 68: 67-72, April 1945.

Renal ectopia is a congenital displacement of the kidney and may be of several degrees and types. There are three general levels which the displaced kidney may occupy: the lower lumbar region or iliac fossa; the brim of the pelvis; below the brim of the pelvis, the true pelvic kidney. The lower the kidney, the nearer the mid-line it usually lies. Ectopia may be unilateral or bilateral. Both kidneys may occupy a pelvic position and be fused to form a "cake" or "shield" kidney. The kidney may be displaced to the opposite side of the body from its natural position. Such a kidney may then be fused with or lie distal to the other kidney. This is known as crossed ectopia, fused or unfused, the former being much more common. Crossed ectopia is differentiated from renal duplication with contralateral renal agenesis by the fact that the two ureters open on opposite sides of the trigone.

Twenty-three cases of renal ectopia (15 observed at autopsy, 8 clinically) are reported. Thirteen patients in this series (56.6 per cent) were females. Five (62.5 per cent) of the 8 patients in which the renal ectopia was diagnosed clinically were under thirty years of age. In 5 cases there were other congenital abnormalities of the ectopic kidneys and in 4 there were congenital lesions of the other kidney.

Pain, usually in the lower part of the abdomen or back, was the chief complaint. Three patients were operated upon and the ectopic kidney was removed, all primarily because of pain. In the majority of cases, however, renal ectopia was apparently compatible with comfort and good health. One patient with a solitary pelvic kidney and absence of the vagina was subjected to surgical exploration—without preliminary urological study—because of a pelvic mass and pain. This case emphasizes the importance of urologic study of all patients with congenital abnormalities of the genital organs.

Case of Crossed Renal Ectopia. Quince B. Coray. *Urol. & Cutan. Rev.* 49: 216-217, April 1945.

Crossed renal ectopia is a rather rare anomaly. It is thought to be due to an abnormal vascular fixation. The ectopic kidney may be anywhere in the abdomen. In most instances, it lies in a transverse position over the sacrum and is fused with the opposite kidney, the renal pelvis facing either ventrally or medially. Symptoms may be absent or minimal. Calculi and infection are frequent. The diagnosis can be made only by means of urography. A case is reported.

MAURICE D. SACHS, M.D.

Solitary Cyst of the Kidney. Case Report. David Kershner and Leon N. Kessler. *Am. J. Surg.* 68: 124-126, April 1945.

A case of solitary unilateral congenital cyst of the kidney in a 38-year-old woman, diagnosed preoperatively, is reported, with a brief description of the clinical, roentgenologic, and pathological findings.

Radiology of War Injuries. Part II. War Wounds of the Urinary Tract. D. B. McGrigor and Eric Samuel. *Brit. J. Radiol.* 18: 121-126, April 1945.

Wounds of the urinary tract constitute a comparatively small proportion of war casualties. The x-ray examination should start with a plain scout film of the abdomen which includes the diaphragm. Intravenous pyelography is the next step, followed by retrograde pyelography and cystography under screen control if injury to the bladder is suspected.

Penetrating injuries to the right kidney are usually associated with injuries to the liver and duodenum and those of the left with injuries to the spleen and splenic flexure of the colon; 40 per cent of the cases showed injuries to the thoracic structures also. The main functions of radiology in penetrating injuries are the exclusion of thoracic injuries, estimation of the degree of injury and of the condition of the other kidney, and localization of foreign bodies.

Non-penetrating injuries with damage to the kidneys are more difficult to diagnose. In many cases there may be reflex anuria accompanying injuries to other organs.

The signs of rupture of the kidney on the plain film include: scoliosis with the concavity toward the affected side, absence of the renal shadow, obliteration of the psoas line, raised hemidiaphragm, extraperitoneal hematoma, and fracture of the 12th rib. On intravenous urography the following features may be present: diminution or absence of excretion on the affected side, deformity of the pelvis and calices, and extravasation of the dye outside the renal shadow. Retrograde pyelography should be reserved for exceptional cases. Extravasation of the dye outside the renal substance indicates an extracapsular rupture.

Intravenous urography is invaluable in determining late results of the renal injury and should be done at periodic intervals during convalescence.

In bladder injuries radiology is generally used to demonstrate associated fractures of the pelvic bones. For cystography, sodium iodide is considered preferable to air.

SYDNEY J. HAWLEY, M.D.

THE SOFT TISSUES

Roentgenologic Soft-Tissue Studies of the Skin and Subcutaneous Tissue: A Contribution to the Roentgen Study of Edema. Arne Frantzell. *Acta radiol.* 25: 460-479, Nov. 21, 1944. (In German.)

Certain roentgen changes of the soft tissues indicating a minimal subcutaneous edema, difficult of clinical recognition, are described. Films must be made with less contrast than usual and must have maximum definition; 150 cm. film-focus distance is recommended, with 36 to 45 kv. and 300 ma. With double screens an exposure of 1.5 seconds is usual. In the resulting film the skeleton is grossly underexposed, while the musculature presents a more or less homogeneous appearance with translucent streaks where the fatty

tissue separates the muscles or groups. Vascular shadows, often seen peripherally, are in the subcutaneous tissue; without contrast medium the vessels in muscles themselves cannot be shown. The subcutaneous fatty tissues are more radiolucent than the muscles, and are about 1-2 cm. thick. They contain a fine network of lines separating the fat lobuli, and the fascia can be seen as streaks parallel to the muscular planes. The skin is denser, about 1 cm. thick, and marked off from the subcutaneous tissue by a dark line (the "cutis line").

Subcutaneous edema is characterized by three signs: (1) broadening of the subcutaneous fat zone with (2) a marked increase in the reticular markings and (3) broadening and increase in density of the cutis line. These signs are seen in vascular thrombosis, but that this is due to the resulting edema is demonstrated by the fact that they could be reproduced experimentally by injection of isotonic saline subcutaneously, and by the further observation that the signs were identical in simple clinical edema. The diagnosis of deep thrombosis by this sign without the use of a contrast medium is discussed; the author feels that the absence of the signs of edema may be taken to exclude thrombosis even without venography, but not the converse.

LEWIS G. JACOBS, M.D.

THE BLOOD VESSELS

Significance of Calcification in the Ascending Aorta as Observed Roentgenologically. James Jackman and Mortimer Lubert. *Am. J. Roentgenol.* 53: 432-438, May 1945.

The authors have noted a frequent association of calcification in the ascending aorta, as seen in the roentgenogram, with the pathologic diagnosis of syphilitic aortitis. They feel that the presence of such calcification is a reliable sign of syphilitic aortitis, and one that has not been fully appreciated.

Sixty-six cases of pathologically proved syphilitic aortitis were studied. Roentgenograms were made of all these cases, and in 15 (22.7 per cent) calcification in the ascending aorta was demonstrated. The radiopaque shadows were most commonly seen in the right border of the ascending aorta halfway between the aortic valve and the beginning of the transverse portion. The calcification appears only when the syphilitic infection is of long duration. It is significant that the clinical diagnosis of syphilis of the aorta is rarely made in the absence of aortic insufficiency and yet it appears that the proper diagnosis may be made from the roentgenogram alone in a certain group of cases, even though the aortic valve is competent. The calcification of the aorta noted in arteriosclerosis is almost always distal to the ascending portion and is most common in the abdominal portion. In contrast, the calcification in syphilitic aortitis affects the proximal portion and is rarely observed beyond the isthmus or mid-thoracic region. Of 62 cases of severe arteriosclerosis seen at autopsy, only 3.2 per cent were found to have calcium deposits visible in the ascending aorta on roentgenograms of the chest.

Straight postero-anterior projections of the chest with rapid exposures are recommended. Confusing shadows which may be mistaken for aortic calcification are the angles of ribs, transverse processes of the vertebrae, and calcifications in the bronchi.

CLARENCE E. WEAVER, M.D.

Pathological-Anatomical Basis of Tumor Arteriography. An Investigation of the Arterial Vessels of Hypernephromas and Carcinomas of the Stomach. Lars Billing and Åke G. H. Lindgren. Acta radiol. 25: 625-640, Nov. 21, 1944. (In German.)

In this study an attempt was made to determine the differences in the vascularization of tumors and normal tissues, with the object of allowing the eventual diagnosis of neoplasms, and even of determining their malignancy, by intra-vitam arteriography. In the literature on arteriography the characteristics of neoplastic vessels are described as follows: (1) a net of newly formed vessels, mostly of the same caliber, which travel in all directions and, by their irregularity, demonstrate the boundless growth of the tumor; (2) rapid progress of the contrast medium into the veins, at times (in glioma multiforme, for instance) almost suggesting an arteriovenous fistula. Pathologically, the tumor vessels may be "taken over" from the tumor bed or may be newly formed. The latter typically do not have elastic fibers in their walls. In benign tumors and granulations there is differentiation of the walls, a distinctive point.

In order to avoid the poor results of injecting post-mortem specimens (due to the clotting of blood in the vessels), operative specimens from hypernephromas and gastric carcinomas were studied by injection, dissection, and sectioning. The normal vascular pattern of the kidney and stomach is well known. The injection medium was a gelatine suspension of barium sulfate with particles of 1 to 4 micra; this permitted ready filling of the capillaries. No arteriovenous anastomosis larger than a precapillary was found. Roentgenographic demonstration of vessels 1 to 5 micra in diameter was satisfactory, but the capillaries were not shown.

Fourteen kidneys with hypernephromas were used. The normal pre-existing vessels were pushed aside by the tumor, and the pathological vessels showed a corkscrew-like course with slight widening of the lumen. Such vessels showed absence of elastic fibers in the walls when studied microscopically. In 2 cases vessels 8 to 10 cm. long were found, but generally they did not exceed 5 cm. The diameter varied from 1.0 to 3.75 mm. The tumor growth is apparently bud-like, with fusion and compression of the buds leading to an irregular pattern. The transition point from normal to pathological vessels could not, as a rule, be identified roentgenographically. Vessels in necrotic areas did not fill. By the use of these signs, renal arteriograms made on the operating table might be used to detect the presence of tumor in cases in which the operator cannot feel the growth.

For the study of gastric cancer 8 resected specimens were used. Some difficulty was experienced in getting satisfactory injection, especially in the center of larger tumors, in spite of the use of several vessels. Unlike the normal vessels of the gastric wall, the tumor vessels showed few anastomoses. The wide vessels characteristic of hypernephroma were rarely seen; the usual diameter did not exceed 0.2 mm. Pathologically, the small vessels were similar to those of hypernephroma, but the larger ones had elastin in their walls, suggesting that their origin was in the tumor bed. Elastin-free arteries had diameters of 0.1 mm. at the most. For contrast, 3 cases of benign ulcer were injected. Their vessels were arranged radially around the ulcer wall, and microscopically the vessels were of an embryonic

type typical of granulation tissue. Thus, differentiation of benign and malignant ulcers should be possible on the basis of these observations.

LEWIS G. JACOBS, M.D.

Classification and Diagnosis of Peripheral Vascular Diseases. Robert H. Goetz. South African M. J. 19: 91-98, March 24, 1945.

This article is voluminous and comprehensive; justice cannot be done it within the compass of an abstract, and readers interested in this subject are referred to the original text with the assurance that they will find it authoritative and of unquestioned value. It is possible, however, to indicate something of its scope and to mention the various presentations in such a manner that readers may have a bit better notion of what phases of the subject receive the greatest stress.

Goetz begins with a very complete classification, in the form of a table, listing all of the peripheral vascular diseases. The *physiology of the cardiovascular system* is then carefully reviewed: the vascular needs of skin are discussed; the vascular needs of muscles; factors influencing the vascularity of each; the effect of heat and cold; the concept of vascular nerves; the origin of the sympathetic fibers controlling vasodilatation and vasoconstriction; the development of collateral circulation in arterial occlusion.

In the *examination of the patient* the importance of *inspection* is stressed and the special signs in erythromelalgia, Buerger's disease, acrocyanosis, the scalenus anticus syndrome, congenital arteriovenous aneurysm, Raynaud's disease, phlebitis, and various types of arteriosclerosis are set forth.

Comparisons are made of the information gained by measurement of skin temperature and plethysmograph readings; the limitations of the oscillometer are pointed out. Angiography is discussed, and a new technic involving a long exposure (4 seconds) is described.

A differential diagnosis of all the conditions grouped at the beginning of the article is thus laid out along orderly lines, and the basic diagnostic procedures, in their order, are discussed, so that the entire diagnostic approach to the peripheral vascular diseases is much clarified. Particularly clear is the delineation of the scope and usefulness of the various functional circulatory tests, with their special indications and the pitfalls in each.

The article is profusely illustrated.

PERCY J. DELANO, M.D.

Varicose Veins of the Upper Extremity. Report of Two Cases. Samuel Candel. U. S. Nav. M. Bull. 44: 1052-1059, May 1945.

The author gives two case reports of varicose veins in the upper extremity, an unusual condition. Both patients were young adult males. The main complaint was swelling of the affected arm and some difficulty in motion. No other physical findings of note were mentioned. Venograms were made in both cases, and in the first case demonstrated normal veins in the right extremity and distinct dilatation of the basilic and axillary veins on the left side. No evidence of obstruction or thrombosis could be demonstrated. In the second case, the venogram showed a tortuous varicose vein in the affected upper extremity. No mention is made of therapy aside from bed rest and elevation of the arm.

The differential diagnosis in this condition is dis-

A brief discussion of orchiectomy and its benefits in der males with cancer of the breast (6 patients) is also presented.

R. S. MACINTYRE, M.D.
(University of Michigan)

Round Cell Tumor of Bone Resembling Ewing's tumor. Robert J. Reeves. *South. M. J.* 38: 302-306, May 1945.

Two case reports of highly radiosensitive tumors of similar histologic appearance are presented. In the author's own case, in a 9-year-old girl, the neoplasia, presumably originating from the body of the mandible, showed the histologic appearance of Ewing's tumor. Operative removal was followed by irradiation (2,000-200 kv.). A recurrence two years later was also surgically removed and 2,500 gamma roentgens of radium were given locally. A further recurrence in 1938, after another interval of two years, was treated with roentgen rays, 3,000 r, and in 1940 a second series of 2,000 r was given. In June 1941 the left mandible was removed and a left neck dissection was done. The histologic examination showed large masses of tumor cells, chiefly of the round-cell type. A right neck dissection four months later was followed by the insertion of radium needles for a dose of 3,000 gamma roentgens. Chest films at this time were negative but six months later showed masses in the right lung, and a possible mass in the liver, elevating the diaphragm. These disappeared following irradiation, and examination in July 1944 showed no evidence of tumor. Eleven years after onset the patient was without complaint.

The second case, obtained from Dr. Vincent Archer, was that of a 6-year-old girl, whose chest was filled with nodular metastases thought to be primary in a rib. The histologic diagnosis was myeloma. Following administration of 2,400 r, all signs of tumor vanished and the patient was well ten years after onset.

MAX MASS, M.D.

Organization and Administration of a Gynecologic Tumor Clinic, with Certain Observations Concerning Therapy. Clayton T. Beecham and Thaddeus L. Montgomery. *Pennsylvania M. J.* 48: 697-700, April 1945.

While many institutions do not possess a group of highly trained specialists, there is usually sufficient talent available to organize a gynecologic tumor clinic if those interested will work in a common direction. In the institution about which the authors write, the gynecologists were treating cervical cancer with their own stock of radium. "When the cases got too bad for them, they were sent as a last resort to the radiologic department." The radiotherapists, on the other hand, were doing their own gynecologic examinations; they formed their own opinions and conducted treatment accordingly. Believing that the knowledge and technical skill of the one group should supplement the other, a working arrangement was made between the two.

The clinic, as formed, is headed by a gynecologist, whose duty it is to see in consultation all cancer cases admitted to the ward or out-patient service. He establishes records and participates in decisions as to the mode of treatment. The insertion of radium is done under his supervision and only in special cases is the radium therapist called in for consultation. The radium and screening material are prepared in the radiologic department. "X-ray therapy is conducted

by the department of radiology at a time which is decided upon in the individual case." The radiotherapist is allowed to examine the patient once after giving a series of treatments and thereafter he must consult the gynecologist's notes for the evaluation of ultimate results. He may attend the gynecologic follow-up clinic if he wishes.

The authors have treated 90 patients with carcinoma of the uterus, ovaries, vulva, vagina, and tubes, and have been able to maintain a complete follow-up on all of them, but they do not give their end-results.

In carcinoma of the cervix, for all but minimal lesions, deep therapy is employed first, since thereby the infection in and around the cancer is cleared up, the size of the tumor is reduced, lymphatics and blood vessels are sealed off, and many tumor cells are destroyed. Two portals are treated daily, with 180 kv. constant potential, 15 ma., 50 cm. distance, 0.5 mm. Cu + 1.0 mm. Al filtration. A total of 2,000 to 2,500 r (in air) are given to each of six portals. About two weeks after the completion of the series, 40 and 60 mg. of radium are inserted into the uterus in tandem, with a filter of 0.5 mm. platinum and 1.0 mm. stainless steel. This is left in place thirty-six hours. "The following day a vaginal bomb containing 120 mg. of radium screened by 0.5 mm. platinum and 2.0 mm. copper is applied successively to the portio vaginalis and both parametrial regions for 100 mg. hours each. Thus the average case receives 6,000 mg. hours of radium."

Carcinoma of the fundus must be diagnosed by curettage if it is to be found early. The patient should be hospitalized and an anesthetic given if one is to scrape the entire canal sufficiently well. The author recommends preliminary x-ray therapy followed by panhysterectomy.

The primary lesion should always be removed in carcinoma of the ovary even though there be abdominal metastases. The author has 8 patients who had advanced ovarian cancer alive and apparently well following operation.

JOSEPH T. DANZER, M.D.

Diagnosis and Treatment of Carcinoma of the Fundus Uteri. Herbert E. Schmitz, John F. Sheehan, and Janet E. Towne. *Illinois M. J.* 87: 194-197, April 1945.

The early diagnosis of adenocarcinoma of the uterine fundus is necessary to obtain good end-results in the treatment of the disease. As hospitalization for diagnostic curettage is not always possible, the use of the vaginal smear holds great promise and deserves careful study after familiarization with the technique.

For a study of the effects of roentgen and radium rays on adenocarcinoma of the fundus, 5 patients in whom the disease was either confined to the endometrium or just beginning to show myometrial invasion were irradiated and subsequently submitted to hysterectomy, after intervals of three, four, five and eight months, respectively. A total dose of 6,000 mg. hours of radium was delivered within the uterus, divided equally into three doses, given on the first, eighth, and sixteenth days. The patient received x-ray therapy on the days that the radium was not in the uterus, a total of 4,000 r (with back-scatter) being delivered within the pelvis in twenty-eight days. Factors were 800 kv. maximum from a double pulsating Villard current, a load of 10 ma. on the x-ray tube, filtration equivalent to 10 mm. copper, a focal skin distance of 70 to 86 cm., and fields varying from 10 to 20 sq. cm. The half-value

by a renewal of mitotic activity. After a dose of 5 n or more, the return of mitosis was characterized by a distortion of the phase ratio. Degenerate forms appeared in one to three hours in all cases.

The authors compare their observations with those made in an earlier study of the effects of gamma rays (Tansley *et al.*: Brit. J. Ophth. 21: 273, 1937). The recovery phase is not delayed after neutron irradiation as it is after gamma irradiation. The compensatory rise in mitosis seen after gamma irradiation is present only after the shortest neutron exposures. Cell degeneration occurs sooner after neutron than after gamma irradiation. The latent period is not seen after neutron exposure. With neutrons, therefore, there appears to be more direct killing and less wounding of cells.

SYDNEY J. HAWLEY, M.D.

Action of Neutrons on Bacteria. F. G. Spear. Brit. J. Radiol. 17: 348-351, November 1944.

The lethal effect of neutrons on *B. coli* and the spores of *B. mesentericus* was found to follow an exponential curve. The effect was the same in quality but different in degree as compared with the effect of other radiations on the same organisms. Direct comparison of the effect of neutrons and of gamma radiation is not possible, as there is no common measure. The ratio of gamma ray dose to neutron dose for a 50 per cent lethal effect was 3.2 for *B. coli* and 5.3 for *B. mesentericus*.

SYDNEY J. HAWLEY, M.D.

Evidence of the Peripheral Action of Vitamin D from X-Ray Diffraction Studies. C. I. Reed and B. P. Reed. Am. J. Physiol. 143: 413-419, March 1945.

X-rays were used for diffraction studies of the cortices of the long bones in rats to determine the peripheral

action of vitamin D. The severe disorientation of the crystal pattern in experimentally induced rickets began to show improvement by the time antirachitic healing was complete, following return to a basal diet or the administration of vitamin D. Since the vitamin D added to the rachitogenic diet did not restore growth rate, it is concluded that reorientation is not due to somatic growth per se. These data indicate a peripheral catalytic action of vitamin D in osseous tissues.

Effect of Insoluble Radiophosphorus (Chromium Phosphate) When Applied Interstitially in the Treatment of Adenocarcinoma of the Mamma in Mice. Harry Allen, L. H. Hempelmann, Jr., and Nathan A. Womack. Cancer Research 5: 239-246, April 1945.

Chromium phosphate, an insoluble salt of radiophosphorus, was injected in saline suspension around the periphery of transplanted spontaneous mammary adenocarcinomas in the C57 strain of mice, with resulting regression of the tumor. It was found that the mice could tolerate less than 1 mc. of the radioactive material at a single injection. About 0.1 mc. seemed to be the optimum dose for neoplasms less than 2 cm. in diameter; those over 2.5 × 2.5 cm. in size were not cured, and their bearers died, apparently from infection and toxemia associated with necrosis of the tumor. Where the neoplasms exceed one-fifth of the body weight of the animal, fatal toxemia often results from the absorption of broken down tumor tissue. Smaller tumors, where an adequate but not excessive amount of radioactive material was used, disappeared completely in every instance. Most of the radioactive material apparently remains at the site of injection, although a small portion is carried to the regional lymph nodes, where its action can be observed. There is no microscopic evidence of distant parenchymatous damage.



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Roentgen Changes Associated with Pancreatic Insufficiency in Early Life¹

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PANCREATIC fibrosis is being recognized with increasing frequency and it is now known to be one of the important causes of death in infants and young children. In 1938, Blackfan and May (3) found 35 cases in 2,800 autopsies done in a period of fifteen years. In the same year Andersen (1) reported 49 cases, an incidence of 3 per cent, in her necropsy records. In the year 1942 the records of the Children's Hospital (Boston) showed that 12 per cent of the autopsied cases exhibited pancreatic fibrosis of a significant degree. Although there have been several excellent reviews (1, 5, 6) and numerous papers devoted to certain aspects of pancreatic insufficiency, the literature shows a decided paucity of description of the roentgenologic aspects. The moment seems opportune, therefore, for the presentation of our experience with over 50 patients who have manifested the changes of pancreatic fibrosis.

A brief review of the clinical and pathological findings is necessary for a proper understanding of the roentgenologic changes associated with this disease. Pancreatic fibrosis may be produced by a process limited to the pancreas and adjacent structures or it may be part of a generalized disease that is as yet incompletely understood, although the work of Farber

and his associates and others have done much in furthering our knowledge of the subject.

Farber (7) has listed the following causes for a purely local process: Atresia or stenosis of pancreatic ducts; duct obstruction associated with certain forms of annular pancreas, and obstruction produced by calculi, neoplasms, and healed pancreatitis. In those instances where pancreatic fibrosis is but one manifestation of a widespread disturbance—and these constitute the majority of cases—there appears to be a failure of formation or a failure of liberation of pancreatic enzymes. Figure 1 shows the typical microscopic appearance, with dilatation of ducts, inspissation of secretion in atrophic acini, and connective tissue replacement and fibrosis. The result of this inspissation and obstruction is pancreatic achylia. Important changes are found in many other organs of the body. Glandular structures in the bronchi and trachea and in the intestinal tract may show marked alteration in the physical character of the secretions, with dilatation of ducts and inspissation of material. Intrahepatic biliary obstruction has been observed. Farber (7) has suggested the term "muco-viscidosis" for this generalized process.

¹ From the Department of Roentgenology of the Infants' and the Children's Hospital, 300 Longwood Ave., Boston, Mass. Presented at the Joint Meeting of the American Roentgen Ray Society and the Radiological Society of North America, Chicago, Ill., Sept. 24-29, 1944.

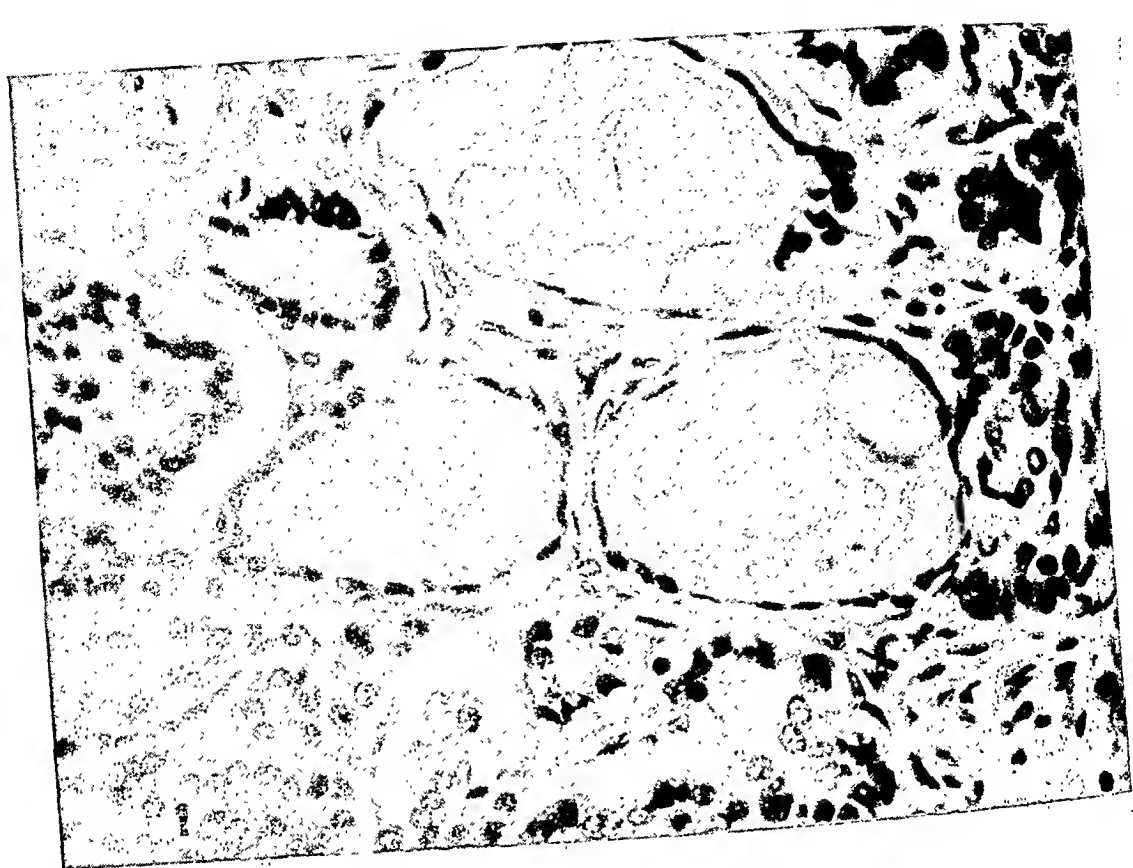


Fig. 1. Photomicrograph of section of pancreas. There is inspissation of secretion in dilated and atrophic acini. A moderate degree of fibrosis is evident.

Fig. 2. Meconium ileus. A segment of bowel cut open along the mesenteric border shows the character of the mucilaginous meconium that fills and obstructs the ileum and colon.

If achylia or marked reduction in the pancreatic enzyme activity occurs before birth, a conspicuous alteration in the physical quality of the meconium takes place in consequence of the absence of tryptic digestion. Figure 2 shows the sticky mucilaginous quality of the meconium that fills and obstructs the ileum and colon. The peristaltic activity of the bowel is insufficient to overcome the obstruction produced by this altered meconium, so that in the newborn infant meconium ileus results

(11). If the pancreatic fibrosis is but part of a generalized disease process associated with this nutritional disturbance, there is almost invariably evidence of chronic pulmonary disease. The pulmonary disease in its early stages appears to be the result of bronchial obstruction of varying degree produced by thick, glairy, and tenacious secretions in the trachea, bronchi, and bronchioles (Fig. 3). A subacute or chronic staphylococcus bronchitis and bronchopneumonia is soon superimposed. Figure



Fig. 3. Posterior view of the opened trachea and major bronchi from an infant aged twenty months with pancreatic achylia. There is an abundance of thick, tenacious mucus which was obstructing the smaller bronchi and bronchioles. (Reproduced by permission of the A. M. A. Press, from Farber: *Arch. Path.* 37: 238-250, 1944.)

(6). These patients are usually admitted to the hospital in the first week of life with signs and symptoms of intestinal obstruction.

When the effects of pancreatic hypochylia become manifest after birth, there results a chronic nutritional failure that is distinguished with difficulty from celiac disease. There are usually lack of subcutaneous fat and deficiency of muscle tissue particularly about the hips, buttocks, and shoulder girdle, a protuberant abdomen, and frequent attacks of diarrhea with foul and bulky stools with high nitrogen residue

4 shows the external aspect of the lungs as usually observed at autopsy. Marked irregular emphysema is evident, as are small areas of atelectasis. The cut surface of the lung (Fig. 5) will invariably show dilatation of the bronchi and bronchioles, with frequently some destruction of their walls. Peribronchial areas of pneumonia, frequent bronchiectatic abscesses, and areas of connective tissue replacement of lung parenchyma are observed. Clinically, either the chronic pulmonary disturbance or the nutritional failure may dominate the picture. If the pulmonary disease is evident,



Fig. 4. The lungs of a patient aged five years and seven months, with chronic nutritional failure. Pancreatic fibrosis was demonstrated at autopsy. There is marked emphysema with focal areas of atelectasis.

Fig. 5. Cut surface of a fixed lung from a patient aged ten months with pancreatic fibrosis and achylia. The lungs are overexpanded, many dilated bronchi are visible and there are widely scattered areas of consolidation with abscess formation. (Figs. 4 and 5 reproduced by permission of the A. M. A. Press, from Farber: *Arch. Path.* 37: 238-250, 1944.)

the patients will exhibit a severe and usually non-productive cough, air hunger, and occasionally cyanosis. Physical findings may vary considerably.

The diagnosis can frequently be made from the clinical findings and symptoms or by the roentgenologic manifestations on examination of the lungs and the gastro-intestinal tract. A low glucose tolerance or vitamin "A" curve will likewise suggest the diagnosis, but conclusive evidence of

disease is shown by marked reduction or absence of pancreatic enzyme activity. Of the enzymes, trypsin deficiency seems to be most important. With faulty absorption of vitamin "A," a deficiency may result. Blackfan and Wolbach (4) and Farber (8) do not believe that this deficiency plays an important part in the clinicopathological picture of pancreatic fibrosis.

The roentgenological aspects of this disease are of considerable importance, as only too frequently the presence of the pancreatic fibrosis is not suspected until roentgen examination is made. In many instances an accurate x-ray diagnosis is possible. In our last 10 cases of meconium ileus the correct diagnosis was made in 4, while in the last 10 patients with pulmonary disease and nutritional failure the correct roentgen diagnosis was made in 8. Many investigators (9, 10) have mentioned the disturbance of motor function of the gastro-intestinal tract. Attwood and Sargent (2) have described in some detail the roentgen appearance of the lungs in the later stages of the disease. We know of no adequate description of the diagnostic features of meconium ileus. In approximately 60 per cent of patients with meconium ileus it has not been possible with our present knowledge to make a roentgen diagnosis other than that of small bowel obstruction, with rough localization of the obstruction. Figure 6 shows this type of picture. There is pronounced dilatation of small bowel loops with air and fluid levels when the film is made in the erect position. This appearance must differ only slightly from that produced by atresia or marked stenosis of the ileum. In other patients the films of the abdomen show a different appearance, and one that we feel is diagnostic (Fig. 7). There is no abrupt termination of the visualized gas and no terminal dilated loop of bowel to suggest a point of obstruction. It is apparent that a small quantity of gas has been forced into the tenacious mucilaginous meconium. Small and minute bubbles of gas can be seen scattered throughout the distal small



Fig. 6. Meconium ileus in a patient aged three days. There are many dilated loops of small bowel and no evidence of gas in the colon. The appearance is that of intestinal obstruction. The etiology is not evident.

Fig. 7. Meconium ileus in a patient aged two days. Intestinal obstruction with many minute bubbles of gas mixed with meconium suggests the diagnosis.

bowel, and here its caliber is somewhat smaller than that portion of the bowel which is well distended with gas. We have not observed this appearance in any other condition of the newborn. Examination by barium enema has not been attempted, as it was thought to be unwise in the presence of obvious necessity for immediate operation to relieve the obstruction.

Examination of the gastro-intestinal tract has been carried out in all but a few of the patients who showed evidence of the systemic disease associated with pancreatic fibrosis. We have found it difficult and frequently impossible to recognize a motor disturbance of the bowel in very young infants. It is well known that marked variation without known cause is to be expected in the gastric emptying time and the small bowel motility in young infants. Golden (9) states that before the age of one month, and frequently

up to the age of three or four months, the normal small bowel pattern and motor activity of the gastro-intestinal tract are apparently identical with or very similar to that appearance exhibited by an older child with a deficiency state or nutritional disturbance. In older infants, when the adult type of pattern and activity is approached, the roentgen examination is helpful, but it must be emphasized that the changes are not specific for any single clinical entity but will usually lead to a diagnosis of a disturbance of the motor function of the bowel probably on a nutritional basis.

Examination before the administration of the barium meal will frequently show an excessive amount of gas in the small bowel, although admittedly this is difficult to estimate, as considerable gas is often normally present in the small bowel of infants and young children. If the examination



Fig. 8. Film of a patient aged three years and nine months who had pancreatic achylia and nutritional failure for three years and pulmonary disease for two years. There is disturbance of the small bowel pattern with alternating areas of hypertonicity and hypotonicity.

Fig. 9. Film of a patient aged three years and two months who had pancreatic achylia for nine months and pulmonary disease for fifteen months. The mucosal folds in the duodenum appear to be thickened and reduced in number and there is marked disturbance of the motor function of the bowel.

is carried out in the erect position, a few fluid levels may occasionally be observed, an appearance that we feel is compatible with partial ileus of loops of the small bowel. After the administration of barium, motility usually appears hyperactive if diarrhea is a prominent feature, but in the late stages of the disease motility is usually reduced even though a moderate degree of diarrhea may be present. The small bowel pattern shows considerable disturbance, with alternating areas of hypertonicity and segmental dilatation, so that the barium column is broken and exhibits clumping (Fig. 8). Even in the presence of hypomotility, segmental contractions are frequently prevalent and powerful. Only rarely (four cases) have we been able to recognize coarsening of the mucosal folds in the duodenum and jejunum, as observed by Golden in patients with nutritional disturbance. Figure 9 shows that the mucosal folds may be

fewer in number and apparently thickened. The proximal intestinal tract in three patients has been examined by means of a small bowel enema, but no evidence of a gross morphological abnormality could be found, and in these three patients the mucosal folds did not appear to be unduly thickened. The disturbance of the motor function of the bowel can be temporarily corrected by administration of mechoyl (10).

Although the changes that have been described are not diagnostic of pancreatic fibrosis or any other entity, the importance of these changes must not be underestimated. Their demonstration warns of the necessity for further clinical and laboratory investigation. We have observed one patient with partial duodenal obstruction, pancreatic fibrosis, and chronic nutritional disturbance produced by an annular pancreas, and other similar cases have been found postmortem.

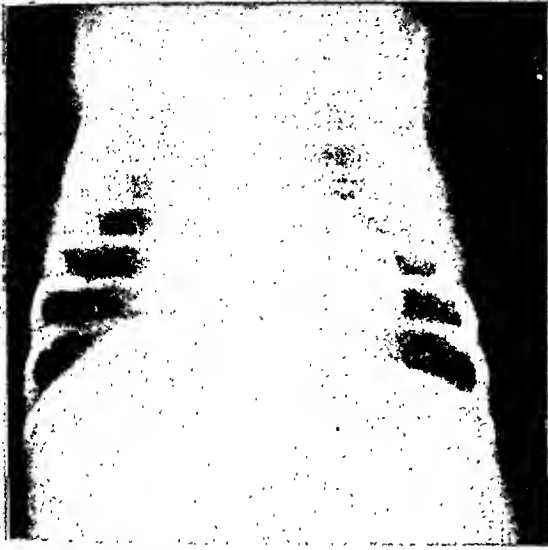


Fig. 10. Film of the chest of a patient aged four months who had cough and difficult respiration for two months. Autopsy showed pancreatic fibrosis and viscid mucus in trachea and bronchi with bronchial plugging.

Roentgen examination of the lungs frequently reveals changes that are quite characteristic. In accordance with the

pathological findings we believe that it is possible to divide the pulmonary findings into two stages. The first (Figs. 10, 11) is that stage where there is evidence of varying degrees of bronchial plugging without any notable superimposed infection. Fluoroscopic examination is particularly helpful at this stage. The volume of the lungs is increased, with flattening and depression of the diaphragm. Many portions of the lung will show increased radiolucency. Widening of the intercostal spaces may be present, and there may be bulging of a few or many of the interspaces as seen at the periphery of the lung. There is the easily recognized picture of obstructive emphysema with poor air exchange. The lungs remain hyperexpanded in expiration. The emphysema is quite irregular; one or more areas of lobular or "plate" atelectasis can be recognized, and lobar collapse is frequent.

In the second stage, when infection has



Fig. 11. Patient aged thirteen months who had cough and respiratory distress for three months. Note the collapse of the middle lobe and marked irregularity of aeration. Autopsy showed pancreatic fibrosis, marked bronchial plugging, and some early bronchitis and peribronchitis.

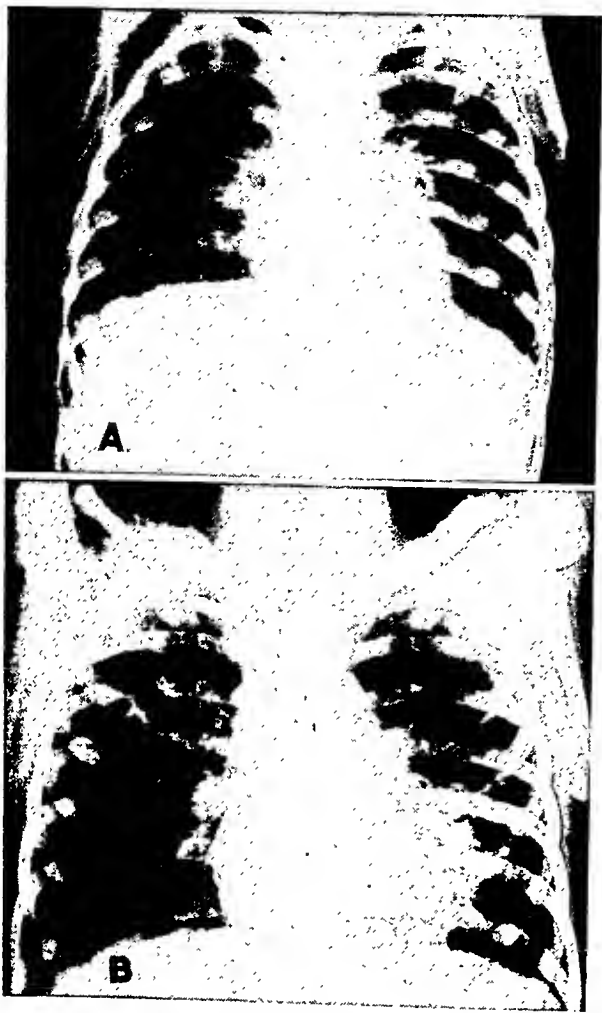


Fig. 12. A. Film of the chest of a patient aged fourteen months who had slight cough for one month, showing only slight irregularity of aeration. B. Six years later the chest showed far advanced changes. Note the irregular emphysema with extensive peribronchial infiltration. Probable duration of chronic staphylococcus pulmonary infection was about five years.

supervened, the roentgen appearance undergoes considerable change (Figs. 12-14). The hilar shadows are accentuated and there is symmetrical increase in the prominence of the bronchovascular markings. Occasionally thickened bronchial walls can be seen, and scattered throughout each lung are multiple areas of peribronchial increased density characteristic of peribronchial infiltration. Some of these areas may be confluent, giving the appearance of lobular pneumonia. Bronchiectasis is usually present, but we have found it difficult to recognize without lipiodol examination, and this we have not felt to be warranted. The end stage, in the patient

with long-standing pulmonary disease, shows irregularly emphysematous lungs with prominent hilar shadows and bronchovascular markings, areas of atelectasis and extensive peribronchial pneumonia, bronchiectasis, and bronchiectatic abscesses. The changes are widespread, the apices and bases are equally involved, and the infiltration often extends to the periphery of the lung, although evidence of pleural reaction has not been observed on any of our films. It is to be assumed that this appearance is not pathognomonic, but the recognition of a long-standing pulmonary disease characterized by obstructive emphysema, atelectasis and fibrosis, and widespread infection, involving all lobes, is sufficient to warrant a tentative diagnosis of pancreatic fibrosis to be confirmed by examination of the enzyme activity of the duodenal juice.

Other changes of less importance may frequently be observed. The shadow of the liver is often enlarged. Examination of the long bones will occasionally show retardation of the bone age and osteoporosis or evidence of vitamin deficiency. It is hoped that, in the future, lipiodol bronchograms and other examinations, such as cholecystography, may yield useful information.

SUMMARY AND CONCLUSIONS

1. Pancreatic fibrosis is an important disease of early life and is being recognized with increasing frequency.
2. The clinical and pathological findings have been briefly discussed.
3. Meconium ileus is the result of pancreatic hypochylia or achylia occurring before birth. In 40 per cent of our recent cases the roentgen changes have been diagnostic.
4. When pancreatic fibrosis becomes manifest after birth, it may exist as a local process associated with a chronic nutritional failure closely resembling celiac disease and producing important changes in the motor function of the intestines.
5. In the great majority of cases, pancreatic fibrosis is part of a widespread proc-

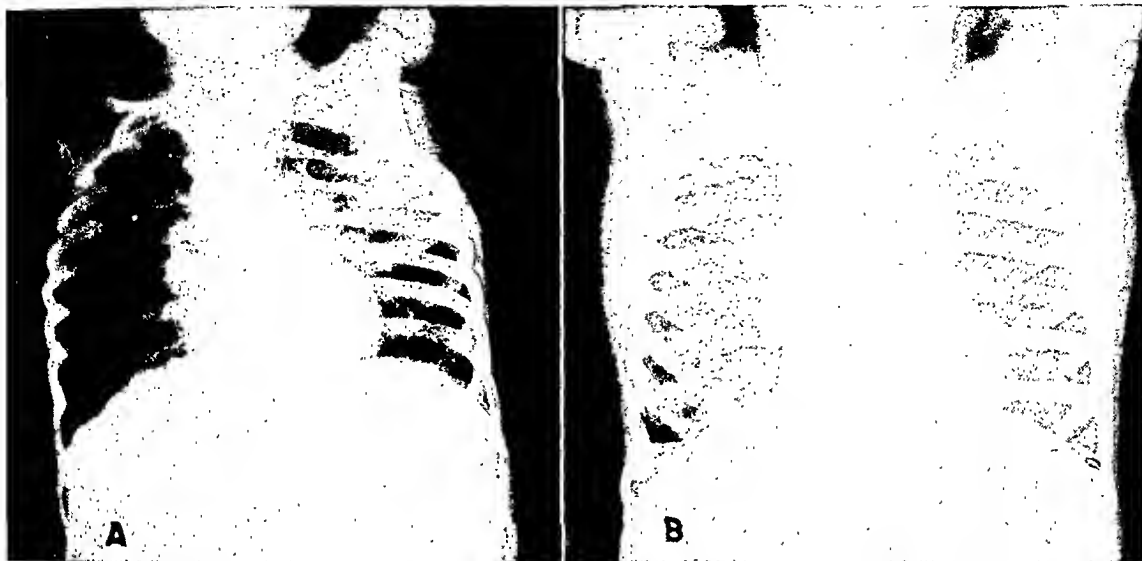


Fig. 13. A. Same patient as Figure 9. There is evidence of bronchial plugging with superimposed staphylococcus infection. B. Same patient ten months later. Note increase in emphysema and spread of peribronchial infection. Autopsy showed pancreatic fibrosis.

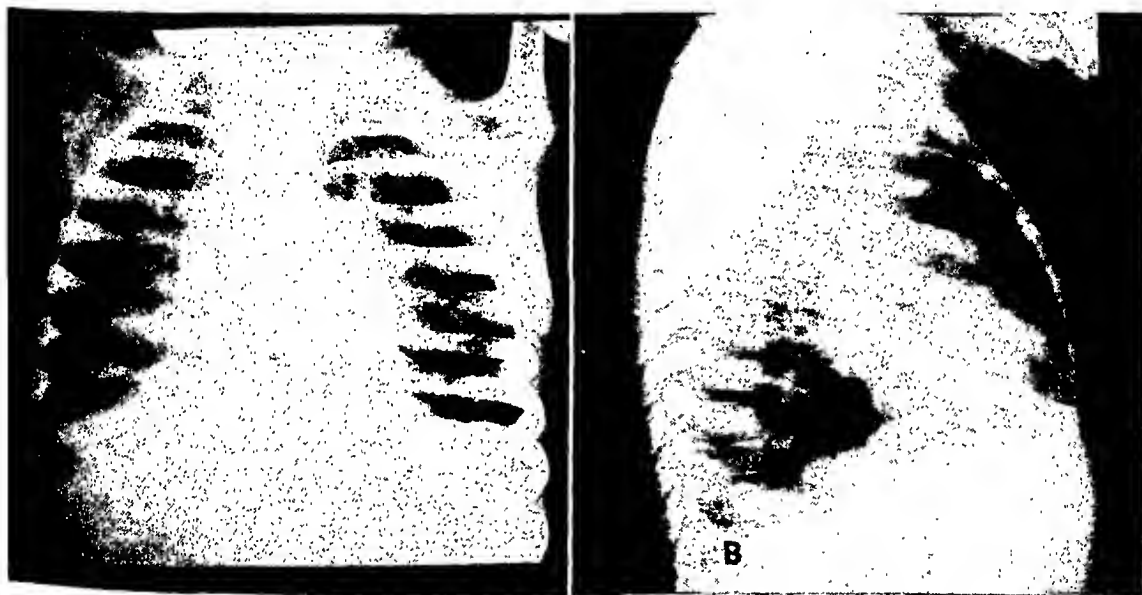


Fig. 14. A. Film of a patient aged eighteen months who had a cough and chronic nutritional disturbance for more than one year. Note emphysema and extensive infiltration. B. Lateral film shows collapse of the right middle lobe. Autopsy showed pancreatic fibrosis.

ess involving many of the glands of the body. Invariably associated with the nutritional disturbance in these patients is chronic severe bronchial obstruction with eventual superimposed staphylococcus infection. The roentgen changes in the later stages of the disease are readily recognized and in many cases are sufficiently characteristic to suggest the diagnosis.

6. Diagnosis of pancreatic fibrosis is confirmed by the demonstration of marked reduction or absence of pancreatic enzymes.

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The Roentgen Diagnosis of Pancreatic Cyst¹

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ALTHOUGH CYST of the pancreas is distinctly not a rarity, it cannot be classed among the common abdominal tumors. In a classical, comprehensive review of this subject in 1898, Korte (1) collected 121 cases from the medical literature. Judd *et al.* (2), in a more recent survey of the subject, state that out of more than 700,000 admissions to the Mayo Clinic between 1921 and 1931, only 88 patients were treated surgically for pancreatic cyst. Rabinovitch and Pines (3) reported 17 cases, in 14 of which operation was done. Virtually all other published articles regarding this entity have dealt with but one or a few patients. The relatively infrequent occurrence of pancreatic cyst is further emphasized by a review of the case records of the University Hospital (Ann Arbor), which reveals that, since July 1935, only 13 patients have received surgical treatment for this entity.

Because of this relatively low incidence of pancreatic cyst and the difficulties commonly encountered in its diagnosis, a brief analysis of pertinent findings which may facilitate that diagnosis seems warranted. Emphasis will be placed upon a particular combination of clinical and roentgenological signs occurring in conjunction with cysts arising in the tail of the pancreas. These signs have not been utilized to their fullest extent in the past, although frequently they are of great diagnostic value.

CLASSIFICATION

The classification of pancreatic cysts is at considerable variance. Suffice it to say that the majority of true cysts are either of the retention or the proliferative type. The former type is more common and is usually due to dilatation of a pancreatic

duct. Korte (1) proposed the term pseudocyst for that type found in more or less close proximity to the pancreas, but apparently not arising in the gland substance, and existing without an epithelial lining. Apparently this type of lesion occurs more frequently than any of the true cysts; it usually arises near the tail of the pancreas.

CLINICAL FINDINGS

The symptoms of pancreatic cyst are not at all distinctive and may be closely simulated by numerous other intra-abdominal lesions. Certainly the most constant and important subjective complaint is pain, but it is so variable in location and extent that it has but little diagnostic value. Loss of weight, weakness, nausea, vomiting, and diarrhea are common but even less consistent symptoms. Jaundice may occur when a cyst grows large enough to obstruct the biliary duct system.

If the cyst is large enough to produce symptoms, a smoothly rounded mass usually may be palpated in the upper portion of the abdomen. This mass may appear suddenly, may slowly enlarge over an interval of months or years, or may fluctuate in both size and shape. The position and mobility of the mass are largely dependent upon the site of origin of the cyst, *i.e.*, the portion of the pancreas from which the cyst arises. When the lesion arises from the head of the pancreas, the presenting mass tends to be localized to the right upper quadrant or epigastrium. Under such circumstances the mass is fixed or only slightly movable. When, as is more frequently the case, the body or tail of the pancreas represents the site of origin of a cyst, the mass usually presents itself in the left upper quadrant and may be quite freely movable. Any of these cysts may

¹ From the Department of Roentgenology, University of Michigan, Ann Arbor, Mich. Accepted for publication in April 1945.



Fig. 1. Retention cyst in tail of pancreas. Cyst clearly discernible by virtue of its own density in relation to density of surrounding soft tissues. Note slight displacement of stomach and upper jejunum.

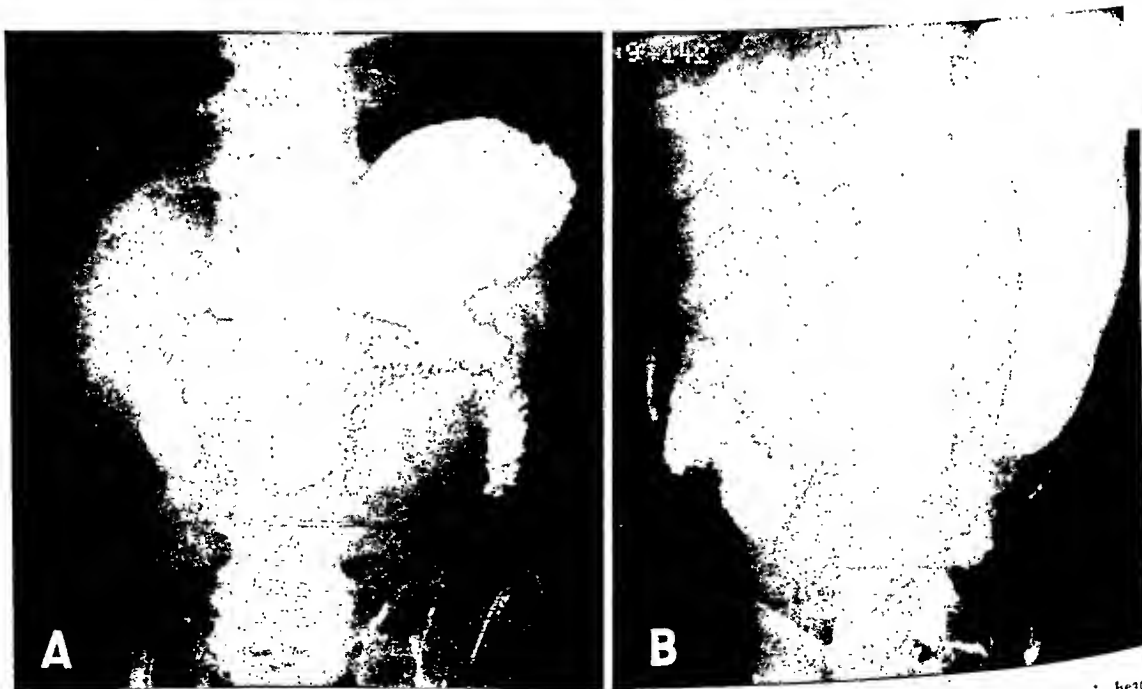


Fig. 2. A. Widening of duodenal loop and upward displacement of stomach due to retention cyst in head of pancreas. The stomach of a normal, hypersthenic person might well produce this same appearance.
B. Large cyst arising from mid-portion of pancreas. There is indentation and pronounced distortion of the lower end of the stomach and the duodenum.

become large enough to occupy the entire upper abdomen.

ROENTGEN FINDINGS

Complete examination of the gastrointestinal tract by roentgen methods is always indicated in patients with suspected pancreatic cyst. Much like the clinical signs of this lesion, the roentgen appearance varies according to the region of the pancreas from which the cyst arises and, furthermore, is considerably dependent upon the size of the cyst and its ultimate position in relation to the abdominal viscera. On occasion, the outline of a pancreatic cyst may be clearly visible in a roentgenogram of the abdomen (Fig. 1), but its presence is more frequently revealed by the extrinsic pressure defects it produces in the barium-filled stomach, proximal small bowel, and colon. Calcium deposits rarely outline the cyst wall.

As a rule, a cyst arising in the head of the pancreas produces widening of the duodenal loop with little or no deformity of the stomach (Fig. 2, A), whereas a cyst of the body of the pancreas displaces the stomach anteriorly and superiorly, with variable distortion of the proximal loops of small bowel. Occasionally, as Bruck (4) has illustrated, the cyst presents more superiorly and medially, resulting in a sweeping indentation of the lesser curvature (Fig. 2, B). None of these findings is particularly diagnostic of cyst to the exclusion of neoplasm.

Concerning a cyst arising from the tail of the pancreas, Case (5) and others have pointed out that such a lesion very frequently produces a smoothly rounded indentation in the greater curvature of the stomach at or just above its mid-portion (Figs. 3, 4, and 5). A lateral view shows a more generalized indentation of the posterior gastric wall with associated anterior displacement of the entire stomach (Fig. 4). The duodenal-jejunal flexure is displaced downward and the splenic flexure of the colon either may be indented along its medial aspect or displaced caudally.

The greater curvature indentation may



Fig. 3. Retention cyst in tail of pancreas producing smoothly margined indentation of greater curvature of stomach. Cardiac and prepyloric regions appear normal. Observe concentric compression of gastric rugae.

show postural variations, but usually is best demonstrated with the patient in a prone, right anterior oblique position. Although the defect is not demonstrable in all patients having a cyst arising from the tail of the pancreas, it occurs often enough to warrant more emphasis than it has been accorded in the past. Of the 13 patients treated surgically for pancreatic cyst in this hospital, 7 had a cyst arising in the tail of the pancreas. Five of these 7 patients showed the greater curvature deformity just described.

DIFFERENTIAL DIAGNOSIS

Conceivably, an enlarged spleen, splenic cyst, mesenteric cyst, omental cyst, or retroperitoneal neoplasm might very well produce a similar localized indentation of the mid-portion of the greater gastric curvature, but such has not been our experience. In an exhaustive search of the University Hospital files, the only recognized

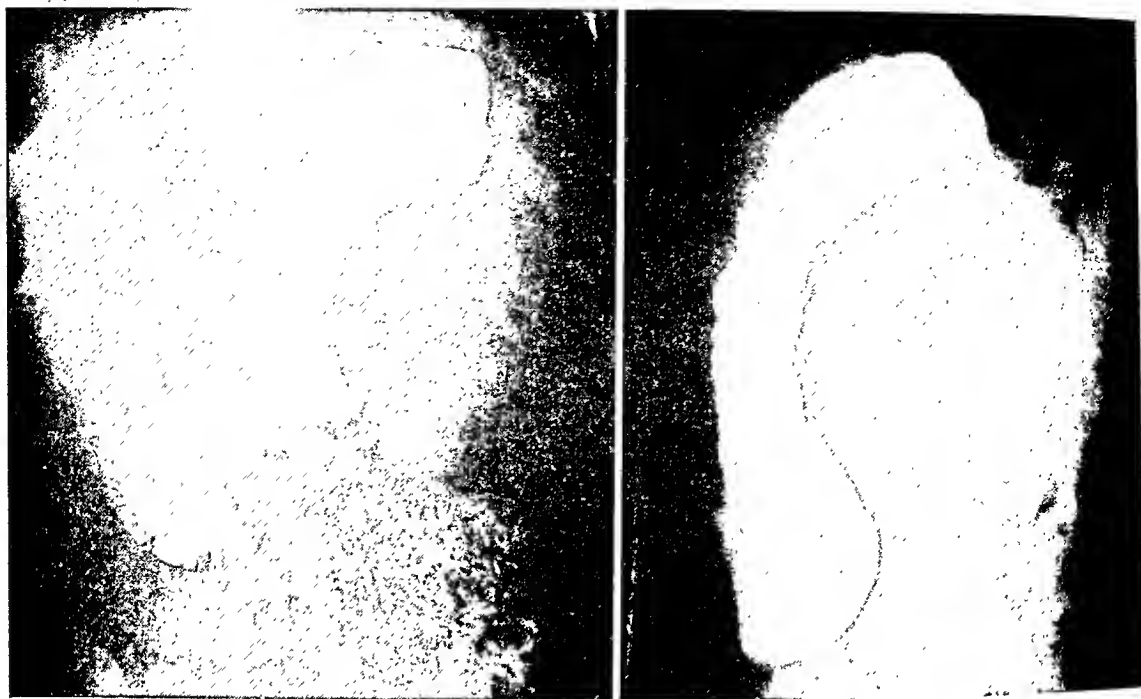


Fig. 4. Characteristic indentation of greater gastric curvature by retention cyst arising in tail of pancreas. Lateral view shows anterior indentation and displacement of stomach. Note downward displacement of duodenal-jejunal flexure.

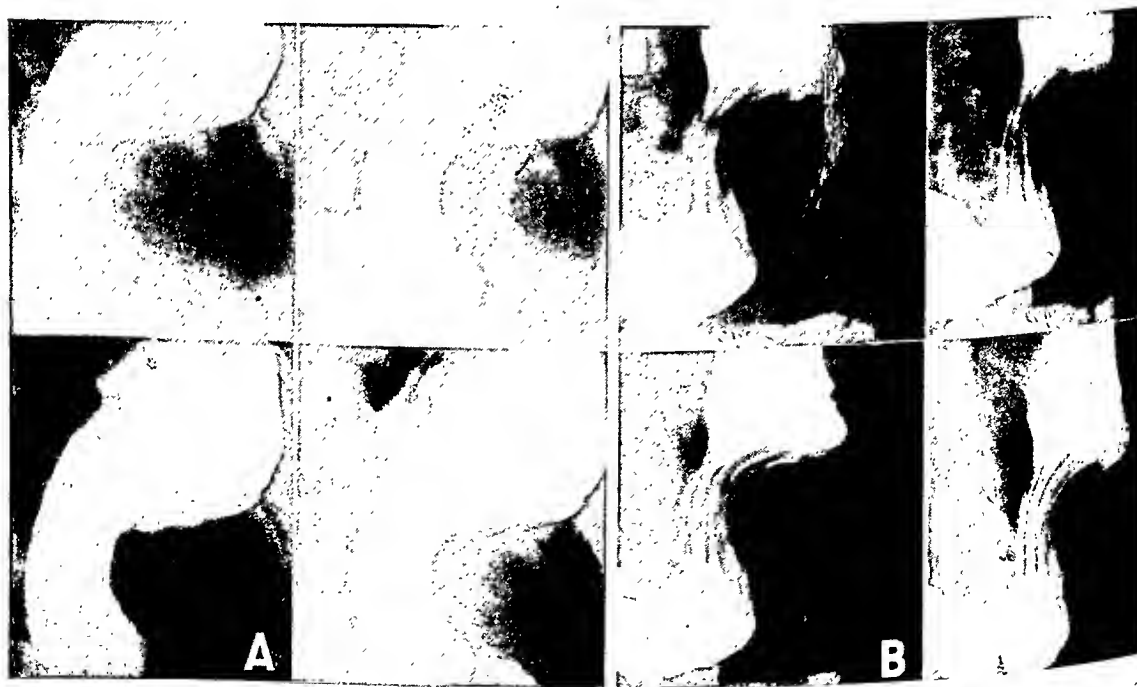


Fig. 5. A. Serial set showing deformity produced by cyst adherent to tail of pancreas. Histological examination of the excised specimen showed it to contain remnants of the wolffian body.
B. Another retention cyst arising in tail of pancreas and producing pronounced greater curvature indentation. Note similarity to Figures 3, 4, and 5, A.

extra-alimentary masses which simulated the greater curvature deformity, and at the same time produced anterior displacement of the stomach, were a congenital cyst of wolffian body origin (Fig. 5, A) and a neoplasm arising from the lower pole of the left kidney. Incidentally, the wolffian body cyst was described in the surgeons' operative note as a cyst arising from the tail of the pancreas, and it was not until histological examination of the specimen was done that the true nature of the lesion was ascertained. Pycelography readily identified the renal lesion.

SUMMARY

The importance of anterior displacement of the stomach and smoothly rounded indentation relatively high on the greater gastric curvature as a combination of roentgen signs suggestive of cyst in the tail of the pancreas should be clearly appreciated. This is especially true when such deformity is encountered in conjunc-

tion with a rounded, ballotable, freely movable mass in the left upper quadrant of the abdomen. Under such circumstances, the roentgenologist not only can make a diagnosis of pancreatic cyst with reasonable assurance of being correct, but he can be of further assistance to the surgeon by suggesting the exact site of origin of the lesion.

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Congenital Duodenal Obstruction

Report of Six Cases and Review of the Literature¹

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CONGENITAL obstruction of the duodenum, first described by Calder (7) in 1733, was long considered a fatal malformation of the newborn and a subject merely of academic interest. In view of the rapid downhill course within a week or two after birth, the diagnosis was formerly made by the pathologist at the necropsy

ated upon, one-half of whom survived. Due to improved methods, introduced by Ladd (29), Donovan (10), and their co-workers, the mortality rate has been still further reduced. In spite of these advances, however, the disorder has received but little attention in the roentgen literature (20, 26, 35, 44, 45).

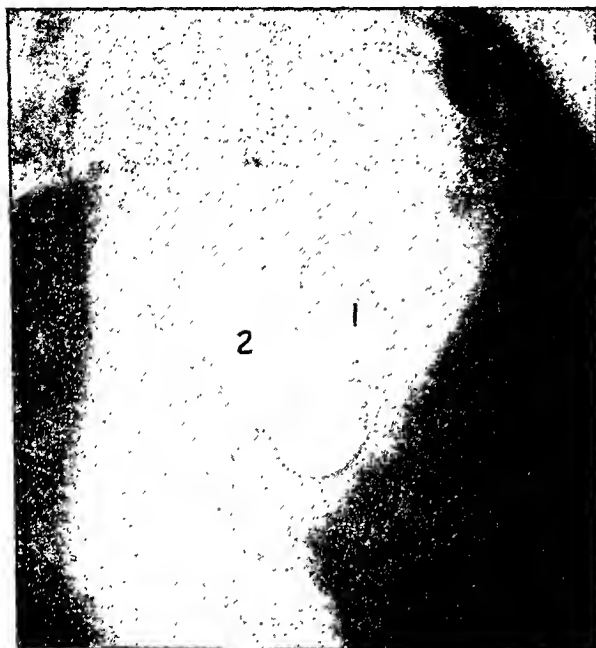


Fig. 1. Case 2. Duodenal atresia at ampulla. Moderate dilatation of stomach (1) and marked distention of proximal portion of duodenum (2). No evidence of gas or barium in the intestine.

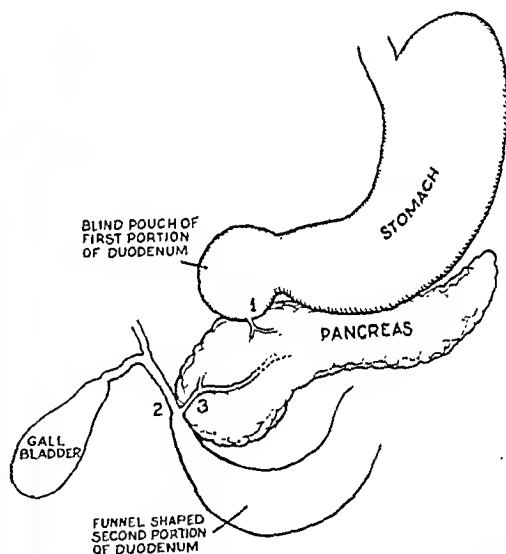


Fig. 2. Case 2. Diagram of autopsy findings of duodenal atresia with anomalies of pancreatic and bile ducts. 1. Duct of Santorini leading into the first portion of the duodenum. 2. Common bile duct entering at the narrow apex of the second portion of the duodenum. 3. Separate opening of the duct of Wirsung near the orifice of the common duct.

table. More recently, however, the condition has been recognized clinically and roentgenologically, and during the past decade surgical procedures have been carried out successfully (2, 5, 11, 12, 13, 18, 19, 24, 25, 31, 38, 40, 43, 46, 48, 49).

So far about three hundred cases have been recorded in the literature (32). Approximately fifty patients have been oper-

In this communication we shall report six cases of congenital duodenal obstruction and summarize the salient features from the literature.

REPORT OF CASES

CASE 1: *Atresia of First Portion of the Duodenum* (French Hospital, Service of Dr. F. C. Holden). A newborn white male vomited persistently after each feeding, at first food, later blood-tinged and

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inally coffee-ground material. The stools contained only meconium. The patient died on the third day of life, having had no roentgen examination.

At autopsy, the stomach and first portion of the duodenum were found to be greatly dilated, the latter forming a blind pouch. There were numerous submucosal hemorrhages. The second portion of the duodenum was completely separated and contained at its funnel-shaped apex the orifice of the common bile duct. The head of the pancreas was closely attached to this region. There was no abnormality of the gallbladder or extrahepatic bile ducts. The pathological diagnosis was congenital atresia of the first portion of the duodenum.

CASE 2: Duodenal Atresia at Ampulla with Anomalies of Pancreatic and Common Bile Ducts. Non-Rotation of Intestine (French Hospital, Service of Dr. F. C. Holden). A newborn white male vomited shortly after the first feeding and continuously thereafter. The stools contained only meconium. A roentgen study revealed a moderate dilatation of the stomach and proximal portion of the duodenum; no barium passed into the jejunum. The intestine contained no gas (Fig. 1). A diagnosis of congenital duodenal atresia was made, but when a laparotomy was performed, on the ninth day, only a non-rotation of the intestine was found. Death occurred five days later.

At autopsy, the stomach appeared moderately dilated. The first portion of the duodenum formed a blind pouch with a small bulge through which the duct of Santorini emptied. The second portion of the duodenum was funnel-shaped, the common duct entering at its narrow apex. Near the orifice of the bile duct a separate opening of the duct of Wirsung was found (Fig. 2). There were no traces of intestinal structure between the two portions of the duodenum. No further anomalies of the abdominal organs were noted. The pathological diagnosis was congenital duodenal atresia at the ampulla with anomalies of the pancreatic and common bile ducts.

CASE 3: Subtotal Duodenal Stenosis at Ampulla (New York Hospital, Service of Dr. S. Z. Levine). A newborn white female began to vomit shortly after the first feeding and had to be fed parenterally. Normal stools were passed. A roentgenogram of the abdomen on the fourth day revealed a gas pocket in the gastric area which apparently outlined the partly deflated stomach. To the right of the mid-line was a larger gas pocket which was believed to represent the grossly distended proximal portion of the duodenum. No gas was seen in the small and large bowel (Fig. 3). The infant showed progressive signs of emaciation and dehydration and died on the sixteenth day.

Autopsy revealed an almost complete duodenal obstruction at the ampulla of Vater. The prestenotic portion of the duodenum and the stomach were greatly distended. The second portion of the duo-

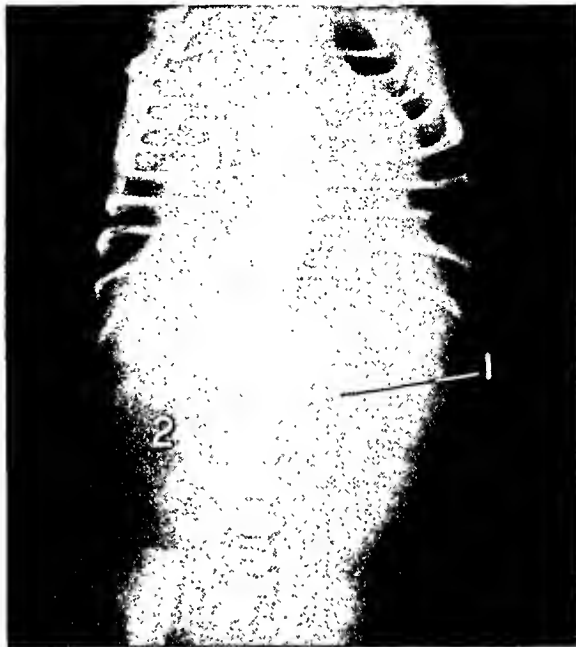


Fig. 3. Case 3. Subtotal duodenal stenosis at ampulla. 1. Small gas pocket in the gastric area, apparently outlining the partly deflated stomach. 2. Large gas pocket in distended proximal portion of the duodenum. Absence of intestinal gas pattern.

denum was narrowed down to only 1 mm. in width, and a thin probe could be passed for a distance of 3 mm. into the third portion. The pathological diagnosis was subtotal congenital duodenal stenosis at the ampulla.

CASE 4: Atresia of the Duodenojejunal Flexure (New York Hospital, Service of Dr. S. Z. Levine). A newborn white female began to vomit bile-stained material after each feeding. The upper part of the abdomen was markedly distended, and the stomach was well demarcated. The liver and the spleen were not palpable. A supine view of the abdomen revealed three gas pockets in the upper and middle abdomen and absence of gas in the small and large intestine. The gas pockets were believed to represent the stomach and the distended duodenum (Fig. 4). In the inverted position the larger duodenal pocket had shifted from the mid-line to the right lower abdomen and showed a large amount of fluid. The other two gas pockets in the gastroduodenal area had become partly deflated, containing only small fluid levels (Fig. 5). A cord-like mass of feces was removed by enema. It consisted of meconium and was negative for bile. With the clinical and roentgen diagnosis of upper intestinal atresia, a laparotomy was performed. The infant died two hours after the operation.

At autopsy, a complete blind ending of the third portion of the duodenum was found 6 cm. distal to the pylorus. The proximal end of the jejunum was closed and completely detached from the duodenum.



Figs. 4 and 5. Case 4. Atresia of duodenojejunal flexure. Figure 4 (left) shows three gas pockets in the upper abdomen, believed to outline the stomach (1), first (2), and second and third (3) portions of the duodenum. Absence of intestinal gas pattern. Figure 5 (right), in the inverted or upside-down position, shows gas pockets in the stomach (1) and proximal duodenum (2) partly deflated, having small fluid levels. A large gas pocket in the distal duodenum (3), shifted to the right lower abdomen, shows a large fluid level.

The intestinal tract was collapsed and contained inspissated pale material. The pathological diagnosis was congenital atresia of the duodenojejunal flexure.

CASE 5: Atresia of the Duodenojejunal Flexure (City Hospital, Service of Dr. C. S. Boyd). A newborn colored male, seen in 1928, failed to retain liquids after each feeding and vomited persistently. The downhill course was so rapid that he died on the fifth day of life.

At autopsy, the duodenum was grossly distended and appeared larger than the stomach, which was also dilated. There was a collapse of the small and large intestine. A veil-like sheet of mucosa completely obstructed the lumen of the third portion of the duodenum slightly beyond the ligament of Treitz. The pathological diagnosis was congenital atresia of the duodenojejunal flexure.

CASE 6: Subtotal Stenosis of the Duodenojejunal Flexure with Mucosal Partition. Non-Rotation of Intestine (City Hospital, Service of Dr. G. R. Irving). A newborn colored female had an uneventful course until the third day of life, when vomiting began, becoming progressively worse thereafter. There was regurgitation of yellowish-green material, which on one occasion was blood-stained. One to two soft brownish-green stools were passed daily. The infant had a weight loss of a full pound

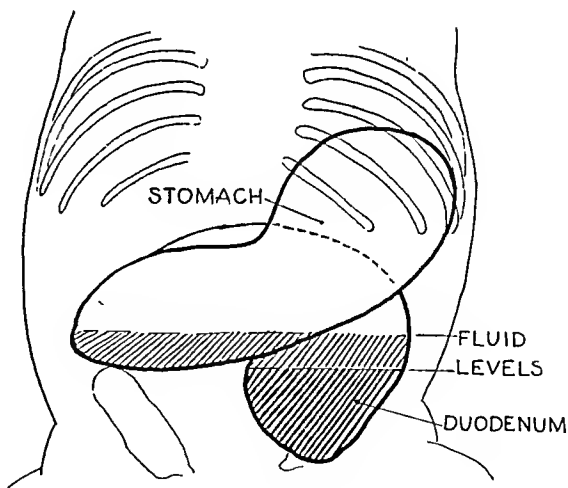
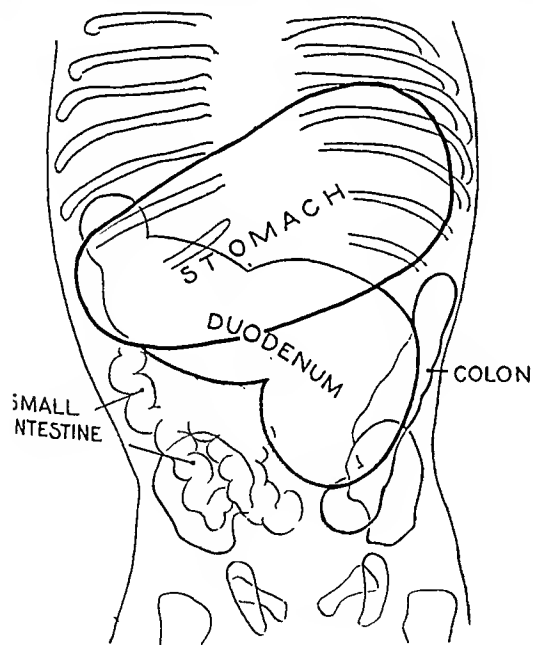
within a week; it became dehydrated and drowsy. The abdomen was soft, no masses being palpable, and peristaltic waves were not visible.

An oral barium study on the sixth day revealed marked dilatation of the stomach. Of special interest was a gross distention of the duodenum which extended from the right flank to the left of the mid-line and curved downward toward the pelvis. The duodenum appeared even larger than the dilated stomach (Fig. 6). Only small amounts of gas were present in the small intestine and colon. In the erect view barium levels were seen in the dilated stomach and in the grossly distended third portion of the duodenum (Fig. 7). In the oblique view the stomach and duodenum presented an hour-glass appearance, the intervening constriction being apparently formed by the pylorus (Fig. 8).

At operation on the same day adhesions were found between the distal third of the stomach and the jejunum. When these were freed and the stomach was rotated cephalad, a vascularized band was seen to extend from the pyloric region to the transverse colon. This was severed, and material subsequently passed into the small intestine. The abdomen was closed without drainage. Vomiting diminished, but on the second postoperative day, it again became severe. A second operation, three days later, revealed dilatation of the stomach and the small intestine. The cecum and ascending colon



Figs. 6 and 7. Case 6. Subtotal stenosis of duodenojejunal flexure. Figure 6 (left) shows dilatation of the stomach and gross distention of the duodenum. Only small amounts of gas are seen in the intestinal tract. Figure 7, an erect view, illustrates the fluid levels in the dilated stomach and grossly distended duodenum.



Figs. 6A and 7A. Diagrammatic illustration of findings shown in Figures 6 and 7.

are found on the left side of the abdomen. Pressure on the stomach caused gas to pass into the jejunum.

The infant improved for a few days, but vomiting recurred and the stools began to contain blood. Finally, a general peritonitis developed, and death occurred on the twentieth day of life.

At autopsy, the stomach and duodenum were found to be greatly distended. At the duodenojejunal flexure was a ring-like constriction due to a white band of the serosa. On opening the intestine,

the point of constriction corresponded to a partition with an eccentric slit-like opening, measuring 3 mm. in length. The pathological diagnosis was subtotal congenital stenosis of the duodenojejunal flexure with mucosal partition and a slit-like opening and non-rotation of the intestine.

DISCUSSION

Congenital obstruction of the duodenum occurs as atresia (19) or stenosis. Atresia



Fig. 8. Case 6. Oblique view showing hourglass appearance of dilated stomach and grossly distended duodenum.

represents a complete closure of the lumen and may vary from a thin diaphragm (28) to complete absence of a segment of the organ, also called aplasia (33). Stenosis represents a narrowing of the lumen, which may vary from one of high degree, subtotal, to partial narrowing of less extent. Atresia and subtotal stenosis are incompatible with life unless surgical repair is carried out within the first week. Partial stenosis, however, has occasionally been observed both in children and adults without seriously interfering with normal life (17, 47, 50). Atresia has been found twice as often as subtotal and partial stenosis, apparently due to the seriousness of the former, while the latter may remain undiscovered (6, 14, 15). This proportion is maintained in our series of four atresias and two subtotal stenoses.

The obstruction may occur in any part of the duodenum, but the sites of predilection are the middle and lower portions. According to Cordes (8) and Spriggs (39), about one-third of the obstructions are

found close to the ampulla of Vater and one-third at the duodenojejunal junction. Of the total obstructions, barely one-third involve the preampullary segment. In our series three were at the duodenojejunal flexure, two at the ampulla, and only one at the first portion of the duodenum.

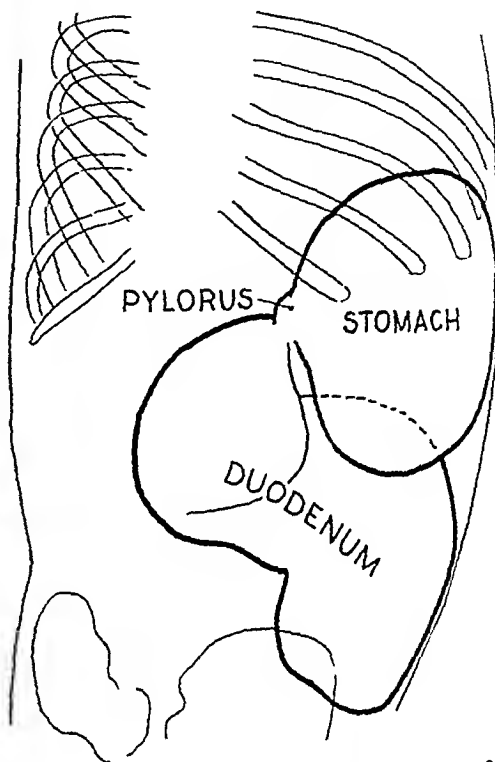


Fig. 8A. Diagram of findings shown in Figure 8.

The types of obstruction have been classified in many ways (4, 36, 42). For purposes of simplification they can be narrowed to four forms (Fig. 9):

1. Diaphragm with or without perforation, the most frequent type (Cases 5 and 6).
2. Filiform lumen (Case 3).
3. Blind ends connected by a fibrous cord.
4. Blind ends without any connection (Cases 1, 2, and 4).

No predilection for sex or race has been found, but a familial occurrence has been observed by Brodsky (3).

The disorder is the result of the persistence of conditions normal for some period of fetal development and occurs at the

ite of embryologic events. A clear understanding is due largely to the work of Candler (41), Forssner (16), Bland Sutton (1), Cordes (8), and others (27).

Between the fifth and twelfth week of gestation, the lumen of the fetal duodenum becomes completely obliterated by epithelial proliferation and changes into a solid cord. At the same period the pancreatic and hepatic ducts are being formed. Should the lumen fail to become patent again, stenosis or obstruction results, dependent upon the degree of normal development.

Extrinsic duodenal factors sometimes play a role during fetal life in the development of obstruction. The persistence of an hepatoduodenocolic ligament, after the rotation of the stomach and duodenum, has been reported as one cause preventing the re-establishment of the duodenal lumen (22). Other causes have been dermoid cysts, mesenteric cysts, annular pancreas, pancreatic tumors and cysts, internal herniae (34), peritoneal adhesions (17), massive volvulus of the bowel (37), failure of mesocolic fixation from arteriomesenteric obstruction or axial rotation of the mesentery, abnormally short or long mesentery, faulty rotation of the midgut, anomalies of the superior mesenteric artery and vein, and excessive development of the anlage of the intestinal villi.

In our Case 6, two factors appeared to play a part; one extrinsic, a band, and the other intrinsic, failure to recanalize. The band may have been the deciding factor. Associated incomplete rotation of the bowel has frequently been described, as in our Cases 2 and 6.

CLINICAL FINDINGS

The clinical findings are those of high intestinal obstruction and vary somewhat depending upon the degree of occlusion and the site of the lesion. In atresia and subtotal stenosis, vomiting begins soon after birth; it may occur from several minutes to two hours after food intake and recurs after each feeding. With a prevaterian lesion, the vomitus consists of ingested

food and mucus, and after repeated attacks it may become blood-tinged. Bile is absent with complete obstruction unless abnormal bile ducts empty into the first portion of the duodenum. The stools contain mucus and bile. In the postvaterian type, the vomitus consists of ingested food and bile, often

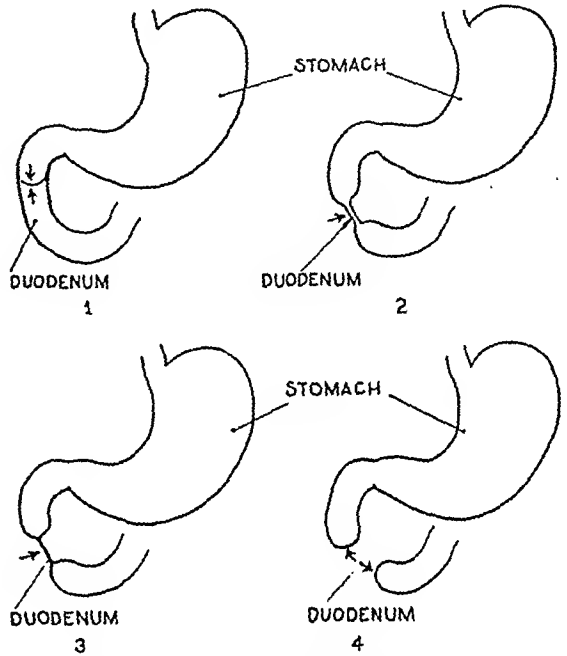


Fig. 9. Four types of congenital duodenal obstruction: 1. Diaphragm (arrows) with or without perforation, most frequent type (Cases 5 and 6). 2. Filiform lumen (arrow) (Case 3). 3. Blind ends connected by fibrous cord (arrow). 4. Blind ends without connection (arrows) (aplasia) (Cases 1, 2, and 4).

mixed with albumin, hematin, and fat. The stools are usually gray, of pasty consistency, and contain mucus. In subtotal stenosis keratinized epithelium, lanugo hair, milk curds, and bile may be found in the meconium. Bowel movements are usually scanty in either type, and loss of weight and dehydration tend to be rapidly progressive.

Inspection reveals a distended epigastrium and sometimes a sunken hypogastrium (23). A soft palpable mass corresponding to the distended duodenum may be present in the right upper quadrant. The distention of the duodenum may be so great as to extend far to the right and to the hypogastrium. Peristalsis of the stomach and the duodenum is frequently visible. In greater degrees of duodenal disten-

tion the waves may be seen running obliquely from right to left. After vomiting spells, the appearance can change to such an extent that the abdominal distention may disappear completely.

The clinical findings with lesser degrees of obstruction are quite different from those of atresia and subtotal stenosis. Vomiting may be delayed for a period of weeks after birth and may occur intermittently as a result of transient volvulus or blocking of the narrow lumen by undigested food.

ROENTGEN DIAGNOSIS

As soon as symptoms and signs suggest duodenal obstruction, a roentgen examination is indicated for confirmation of the clinical impression. Detailed information may then be gained as to the degree of obstruction and the approximate location of the lesion.

Routine abdominal films, taken in various positions, will show gas distention of stomach and duodenum and fluid levels in the erect posture. In atresia there is absence of gas beyond the duodenum (Figs. 1, 3, 4, and 5), but when the obstruction is incomplete, small amounts of gas are usually present in the intestine (Figs. 6, 7, and 8). Films taken with the infant in the inverted position will show fluid levels in the lower abdomen, and the overlying gas shadows may extend downward to the pelvic area (Fig. 5).

If definite conclusions cannot be made from ordinary films, a barium study is warranted for additional information. In spite of the use of a thin solution, the danger of clogging of a stenosed lumen by inspissated barium must be kept in mind. It may be safer to inject only a minimal amount through a duodenal tube and to aspirate the contrast material afterward. The obstruction cannot always be accurately localized when the stomach and duodenum are grossly distended, rotated, and overlap each other. The stomach and the pre-obstructed portion of the duodenum may yield an hourglass appearance (Fig. 8) and thereby the erroneous impression of a so-called bilocular stomach. The

hourglass appearance, however, is pathognomonic of duodenal obstruction. It is due to contraction of the pyloric ring and denotes an extreme distention of the upper duodenal segment. The latter extends usually far to the right and, when the obstruction is at the ampulla or the duodenojejunal junction, turns downward to the left again, the blind end forming a cul-de-sac (Figs. 6, 7, and 8).

Gastroduodenal peristalsis is usually poor, due to an early exhaustion of the over-distended organs, and has been observed only a few times.

A diagnosis of atresia can be made when barium fails to pass beyond the duodenum within six hours and when the intestinal gas pattern is missing. If the obstruction is incomplete, some barium and gas can always be seen in the intestine on the six-hour film. In incomplete obstruction, follow-up studies at twenty-four and forty-eight hours and a barium enema may be advisable to exclude additional stenotic lesions and other congenital changes of the intestine.

DIFFERENTIAL DIAGNOSIS

Obstruction of the jejunum and ileum may be differentiated from duodenal occlusion by a delay of vomiting after the feeding. Pyloric stenosis differs in that it does not become apparent immediately after birth, but, at the earliest, three weeks later. In this condition a pyloric tumor may be palpated, while it is absent in duodenal obstruction. Vomiting associated with an esophageal pouch occurs during or immediately after the feeding but causes no disturbance of intestinal digestion. When vomiting is due to cerebral lesions, acetonemia, or toxic stages of an infectious process, roentgen studies will be helpful in excluding duodenal obstruction.

From a roentgenologic standpoint, the differential diagnosis between obstruction of the small intestine, observed in 15 per cent of cases of congenital intestinal obstruction, and of the third duodenal portion has to be considered. In jejunal and ileal obstruction a dilatation of the

duodenum due to stagnation and retrograde movements may become quite pronounced, thereby simulating duodenal stenosis.

In the European literature, Huber (21) reported cases with clinical manifestations of transient and recurring duodenal obstruction. In the surviving children, however, roentgen findings were normal, and in a few cases which came to autopsy hypoplasia of the mesenteric plexus was found without narrowing of the intestinal lumen. These findings suggested a disturbance of the sympathetic and parasympathetic innervation and possibly achalasia.

PROGNOSIS AND THERAPY

Partial stenosis offers a distinctly favorable prognosis. The fact that this condition is rarely seen suggests that it may frequently remain undiscovered, especially when overshadowed by other congenital abnormalities of the intestine. Subtotal stenosis is far more serious, and infants rarely survive more than three weeks unless the continuity of the intestinal tract is re-established by surgical measures. Atresia is incompatible with life, and an emergency operation is necessary within the first week. The downhill course is rapid, and dehydration may have progressed so far as to make surgical intervention useless.

The operations employed are duodeno-duodenostomy, duodeno-jejunostomy, and posterior gastro-enterostomy, varying with the site of obstruction. In malrotation of the intestine a repair of the mesentery may become necessary. Success of the operation depends, in part, on the presence or absence of additional malformations. Multiple obstructions have been observed (9) and must be carefully searched for at the time of the operation. The patency of the small intestine may be checked by passing a metal-tipped tube, as suggested by Maris (30).

Most essential for a favorable outcome is a close co-operation between obstetrician, pediatrician, roentgenologist, and surgeon. The obstruction may be recog-

nized roentgenologically but later be missed at operation, when co-existent volvulus or incomplete rotation of the bowel obscures the surgical field.

SUMMARY AND CONCLUSIONS

1. Congenital obstruction of the duodenum in its complete form is incompatible with life.
2. Since the downhill course is rapid, the survival depends on a correct roentgen diagnosis and an emergency operation within the first week of life.
3. The characteristic roentgen findings of atresia and subtotal stenosis are dilatation of the stomach and gross distention of the duodenum, sometimes with hour-glass appearance, complete six-hour residue, and lack of intestinal pattern.
4. When the surgeon succeeds in establishing continuity of the intestine and in excluding coexistent malformations elsewhere, the prognosis is favorable.
5. Four cases of atresia and two cases of subtotal stenosis are reported. The essential clinical and pathological features are discussed. The literature is reviewed.

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Diverticulosis of the Jejunum and Ileum¹

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DIVERTICULA are known to occur in practically every portion of the digestive tract. They are most common in the colon and are frequently found, also, in the esophagus and duodenum. Diverticulosis of the small bowel, however, is rare. A recent report by Benson, Dixon, and Waugh (1) states that at the Mayo Clinic, from 1909 to 1942, inclusive, there occurred 122 cases of non-meckelian diverticula of the jejunum and ileum, an average of less than 4 per year. These authors indicate that, in addition, there are only about 200 other recorded examples in the medical annals. Case (2) was able to find but 66 proved cases in the literature in the eighty-year period from 1844 to 1924.

In our clinic at the Boston City Hospital, we have observed a series of 25 cases of diverticulosis of the jejunum and ileum, all of which were seen in a period of two and a half years, from January 1942 to July 1944, and were diagnosed during routine studies of the gastro-intestinal tract with the opaque meal. Because of the relative infrequency of diverticula of the small bowel, it was felt worth while to record the clinical and roentgen manifestations of these cases.

PATHOGENESIS

Diverticula of the small intestine, in common with other types of diverticulosis, may be either congenital or acquired. In the congenital type, the pouch comprises all the layers of the small bowel, while in the acquired group there is a herniation of the mucosa through a defect in the muscular layer. Diverticula are usually, although not necessarily, found along the mesenteric border of the intestine. They may be either single or multiple. The size varies from a few millimeters to several centimeters in diameter. The pouches are

usually smooth and rounded; in some instances they appear oval or elongated. The communication with the lumen of the small bowel is variable and may be large or small. The diverticula occur in any portion of the small bowel from the duodeno-jejunal junction to the ileocecal valve. The upper and middle thirds of the jejunum are the most usual sites, the ileum being the least frequently involved.

Inflammatory changes resulting in diverticulitis may be due to irritation or occlusion by fecal concretions and foreign bodies. Edema and local swelling produce stasis in the diverticulum. The inflammation tends to involve adjacent segments by direct extension and is accompanied by pain, tenderness, and spasm. Perforation may supervene with the formation of either a localized or, more frequently, a generalized peritonitis. In those instances in which the local inflammatory process subsides prior to perforation, areas of fibrosis with partial stenosis or complete obstruction may subsequently develop.

ETIOLOGY

The chief predisposing factors of diverticulosis of the small intestines may be summarized briefly as follows: (1) mechanical, associated with chronic constipation and long-standing over-distention, the pressure of the gas and fecal material forcing the mucosa through the muscularis; (2) degenerative changes, generally thought to be associated with old age, overweight, local irritation, and putrefaction, producing fatty degeneration of the musculature and loss of elasticity of the tissues, with consequent weakening of the intestinal walls. Diverticula appear also to have been caused by adhesions, scarring secondary to healed tuberculosis, and traction from a tumor.

¹ From the Department of Roentgenology, Boston City Hospital. Presented at the Joint Meeting of the American Roentgen Ray Society and the Radiological Society of North America, Chicago, Ill., Sept. 24-29, 1944.

INCIDENCE

Prior to the widespread use of the roentgen method of study of the gastro-intestinal tract, diverticula of the small intestine were practically never diagnosed clinically or at operation and were but rarely recognized at the autopsy table. Reinhardt (3), for example, found only 3 cases in 5,000 necropsies (0.06 per cent), and Edwards (4) 9 in 2,820 postmortem examinations (0.3 per cent). This low incidence may be explained by several factors. The pouches are usually collapsed and shrunken at the time of examination; also, the diverticula are difficult to find if they are empty and small, or in the presence of large amounts of mesenteric fat. Moreover, in many cases thorough search of the entire alimentary canal is not carried out and inflation of the intestines is not practised routinely by many pathologists.

The number of diverticula of the small bowel in series of cases previously observed roentgenologically is likewise very small. Jenkinson (5) found but 3 instances in many thousands of roentgen studies of the gastro-intestinal tract during a period of ten years. Rankin and Martin (6) stated that diverticulosis of the small bowel, exclusive of the duodenal and meckelian types, was found only once in approximately 25,000 examinations; and other observers (7) have likewise reported a very low incidence. With the wider use of the roentgen method of study of the gastro-intestinal tract, these lesions will be discovered with ever-increasing frequency and will prove to be much more common than previously supposed. It is quite probable that many cases are being overlooked even now. As the clinician and roentgenologist are impressed with this fact and become more alert in the search for diverticula of the small intestine they will be diagnosed in far greater numbers in the future.

In our clinic, there were observed 25 cases of diverticulosis of the jejunum and ileum in a period of thirty months. During this time, there were carried out 4,786 roentgen studies of the gastro-intestinal

tract with the opaque meal, making an incidence of 0.5 per cent. All the cases were diagnosed during routine examinations, which comprised fluoroscopic studies and roentgen films of the esophagus, stomach, duodenum, and upper jejunum at the time of ingestion of the opaque meal, subsequent observations after an interval of six hours, and in some instances a twenty-four-hour study. Serial examinations of the small bowel were not done in the greater majority of the patients, being performed only when the routine study indicated that they might prove worth while. For comparison, it may be pointed out that diverticulosis of the colon occurs in from 3 to 10 per cent of all patients (8); and that the incidence of diverticulitis of the large bowel may be as high as 34 per cent (8) of this group. Diverticulitis of the small bowel is very rare, however, and was not seen in any of the cases observed by us.

Diverticulosis of the small intestine appears to be a condition seen primarily in middle and late adult life. Only one of our patients was in the third decade; 3 were in the fifties; the remaining 21 patients were over sixty years old, with one each 75, 78, and 82 years of age. The average age for the entire series was 65 years. The sex ratio was practically equal, 12 females and 13 males.

The distribution, size, and number of lesions in the present series is of interest:

- A. Distribution
 - Jejunum alone.....
 - Jejunum and ileum.....
 - Ileum alone.....
 - Entire jejunum.....
 - Upper third of jejunum.....
 - Middle third of jejunum.....
 - Lower third of jejunum.....
 - Entire ileum.....
 - Upper ileum.....
 - Mid-ileum.....
- B. Size of lesion
 - Over 3 cm. diameter.....
 - From 1 to 3 cm. diameter.....
 - Less than 1 cm. diameter.....
- C. Number
 - Single diverticulum.....
 - 2-4 diverticula.....
 - 5 or more diverticula.....

SYMPTOMS

There is no definite syndrome associated with diverticulosis of the small intestine. In many instances, the diverticula are found during routine roentgen studies of the gastro-intestinal tract and have apparently been present for long periods of time without having produced any evidence of their presence. Moreover, many patients with diverticulosis of the jejunum and ileum have gallbladder disease, peptic ulcer, hiatus hernia, heart conditions, etc., which may be causing symptoms, thus increasing the difficulty of determining whether the complaints are associated with the diverticula or are due to other conditions. Despite the difficulties of differential diagnosis, however, it appears that small intestinal diverticulosis not infrequently gives rise to symptoms that should suggest the diagnosis clinically. The complaints vary from mild, chronic abdominal pain or soreness, accompanied by a feeling of "gas-on-the-stomach," to more severe epigastric distress with nausea and vomiting. The symptoms are usually intermittent in character with a tendency to remissions and exacerbations over periods of months or years. There is, as a rule, no demonstrable relation to meals, bowel movements, or exertion. With distention of the sac, there may occur fullness, cramps, and abdominal pain, either dull or acute in character.

Three of the patients in our series had no complaints referable either directly or indirectly to the diverticulosis. Of this group, two were studied because of generalized superficial adenopathy; the third because of the presence of an abdominal mass. Routine roentgen studies with the opaque meal were carried out in a search for malignant disease of the gastro-intestinal tract, the diverticula being incidental findings.

The remaining 22 patients presented abdominal complaints. These varied widely in duration and severity. In one patient, the symptoms were of but two weeks' duration; at the other end of the scale was a story dating back fifteen years. The commonest complaint was epigastric

distress, which was present in every instance at some time during the history. Eructations of gas were usually associated with the distress. In approximately 50 per cent of the group there was anorexia. Nausea and vomiting were noted in 10 instances. The vomitus consisted principally of undigested food and was small or moderate in amount. In the intervals between attacks of distress and vomiting, there was a feeling of heaviness and gas in the upper abdomen.

Four patients gave a history of tarry stools. One of these had an esophageal hiatus hernia, which was the probable source of the bleeding. The remaining three showed no lesion in the gastro-intestinal tract other than diverticulosis of the small intestine. Two of our group had undergone cholecystectomy, only to return to the hospital after an interval of two or three years, stating that the operations had produced no relief and presenting the same abdominal complaints as previously. Thus, in older people with indefinite abdominal complaints suggestive of peptic ulcer or gallbladder disease, but with no abnormalities demonstrable in these regions, the possibility of diverticulosis of the small bowel must be borne in mind as a cause of the symptoms.

As is the case with diverticula elsewhere in the body, these lesions may be present in considerable numbers, attain relatively large size, and exist for comparatively long periods, without producing complaints or otherwise giving evidence of their presence. On the other hand, they may cause symptoms and must be considered a potential source of danger in view of the ever-present possibilities of retention and stasis of food, secretions, and foreign bodies, infection, perforation, and rupture or stenosis. It is important that the clinician be aware of their existence in any patient under his care. Since these diverticula may not be demonstrable at operation even when one of the above complications has supervened, because of the difficulties involved in exploration of the entire small bowel, the responsibility rests mainly in the



Fig. 1. Large diverticulum of the upper jejunum.

hands of the roentgenologist. We must therefore be constantly on the lookout for these lesions and utilize every method of demonstrating them in every suspected case.

If acute diverticulitis of the small bowel develops, the symptoms may, as in colonic diverticulitis, be closely similar to those of appendicitis except for the difference in the location of the pain, tenderness, and spasm. Nausea and vomiting are more apt to occur with inflammation of small bowel diverticula because of their much higher location in the gastro-intestinal tract.

ASSOCIATION WITH OTHER LESIONS

Case (2), writing on this topic twenty years ago, noted the frequent association of diverticulosis of the small bowel with diverticula and other congenital anomalies elsewhere in the body. In our series, likewise, there was found to be an unusually high incidence of diverticula of the duodenum and colon and, also, esophageal hiatus hernia with protrusion of a portion of the stomach through the esophageal orifice of the diaphragm. Eleven of our patients presented diverticula of the duodenum. Of these, 8 were in the descending portion, 3 were in the cap or bulb, and 1 was in the third part. One patient had two

duodenal diverticula, one each in the second and third portions. Thus it will be noted that in 44 per cent of our cases there was simultaneous diverticulosis of the duodenum and small intestines, an incidence too high to be coincidental and indicative of the fact that similar factors are doubtless present in the various portions of the alimentary tract to account for the presence of the diverticula.



Fig. 2. Solitary diverticulum of the jejunum.

In 6 of our cases of diverticulosis of the small bowel, there were also diverticula of the colon, an incidence of 24 per cent. There was only one instance of esophageal diverticulosis. This patient was of unusual interest, however, in that he presented three diverticula of the esophagus, a large diverticulum of the second portion of the duodenum, a dumb-bell shaped diverticulum of the upper jejunum, multiple diverticula of the colon, and a small esophageal hiatus hernia.

Worthy of note, also, was the finding of five cases of esophageal hiatus hernia in our series, with protrusion of a portion of the cardia of the stomach through the esophageal orifice of the diaphragm into the thorax. Two of the hernias involved approximately one-half of the stomach; the others were small. This incidence of hiatus

ernia, 20 per cent, is also distinctly above the average.

ROENTGEN DIAGNOSIS AND METHODS OF STUDY

In most clinics, in performing routine roentgen studies of the gastro-intestinal tract, a preliminary film of the abdomen is taken. A gas-filled diverticulum may occasionally be demonstrable at this time.



Fig. 3. Large diverticulum of the jejunum, indicated by the arrow. Other smaller jejunal diverticula are also visible, one overlying the spine and two in the left upper quadrant.



Fig. 4. Multiple diverticula scattered throughout the small bowel (straight arrows). Diverticula of the colon with retained barium from a previous opaque enema (curved arrows).

above, this zone being due to intestinal contents and secretions.

In the presence of a diverticulum, thorough roentgenoscopic observations with manual palpation should be carried out in all positions, including the upright, to determine mobility, spasm, and tenderness. Diverticula of the upper jejunum may be best observed within a few minutes to an hour after the ingestion of the opaque meal. Those occurring lower in the jejunum and ileum may not be visualized until three, six, or twenty-four hours later. In many clinics, during routine examination of the gastro-intestinal tract, little if any attention is paid to the small bowel. The six-hour observation is used in many instances to determine whether or not there is gastric stasis and to note the position of the head of the barium column. Not infrequently the entire small bowel is practically empty at this time. Unless there is stasis in the diverticula, they will be entirely overlooked and the diagnosis missed, their presence not even being suspected.

While in most clinics it is not practicable to carry out special studies of the small

Accurate diagnosis of diverticulosis, however, is not possible by this means, and full reliance cannot be placed on this method alone. Roentgen diagnosis of diverticulosis of the small bowel is dependent on the demonstration of the barium-filled pouch or pouches adjacent to and communicating with the lumen of the intestine. The sacs are usually rounded or oval in shape and may be partially or completely filled with the opaque material. With the patient erect, the barium mixture occupies the dependent portion of the diverticulum and forms a horizontal fluid level with a gas shadow in the upper portion of the sac. In lateral decubitus, similar findings are present. In some instances, there is a layer of slightly increased density between the barium and gas shadows described



Fig. 5. Multiple diverticula of the small intestine.

bowel in all cases, it is definitely possible to miss many cases of diverticula of the small intestines unless particular attention is paid to the passage of the opaque meal through the various segments of the jejunum and ileum. Roentgenoscopic observations of the stomach and duodenum should always include study of the upper jejunal loops. Diverticula in this area may be obscured by the overlying stomach and are demonstrable only by manual displacement of the stomach during roentgenoscopy or the use of lateral and oblique views. If there is any clinical suggestion of disease of the small bowel, observations should be made at intervals of one to two hours after the ingestion of the opaque meal until all the loops have been visualized. Also, at the twenty-four hour observation, retention in diverticula should be carefully sought for. If stasis in the pouch is present, observations should be continued daily until complete emptying has taken place.

During opaque enema studies, filling of the terminal loops of ileum is frequently possible, affording an opportunity to examine this portion of the alimentary tract. More common use of the so-called "small-

bowel enema," in which the barium mixture is introduced through a tube lying in the duodenum will permit of complete and accurate study of the small intestine. With marked delay in the motility of a foreign body, the possibility that it is retained in a diverticulum must be borne in mind, and opaque meal studies carried out for localization. We are constantly impressed by the fact that so little attention is paid to the small bowel in many clinics. This is deplorable, as important lesions of the jejunum and ileum may be overlooked because of this carelessness.

TREATMENT

Therapy of the patient with diverticulis is directed primarily to the avoidance of all factors which may result in the development of obstruction or diverticulitis, there being no form of medical treatment which directly influences the diverticula themselves. Over-distention of the intestinal tract, constipation, and stasis are to be particularly avoided. Obesity appears to be an important factor and should be controlled by dietary measures. A low-roughage diet is indicated. Our cases were treated with bed-rest for periods varying from one to eight weeks in duration, no special dietary restrictions other than the above being imposed. This usually produced relief, and all were improved at the time of leaving the hospital. Surgical approach is not difficult, as the lesions are easily mobilized and can usually be brought into the operative field with relative ease. Therefore, if the symptoms are sufficient to warrant laparotomy, there can be no objection to operation, and the mortality should be no greater than in appendectomy or similar abdominal operations.

SUMMARY

Diverticula of the jejunum and ileum are relatively uncommon, but with modern roentgen methods of diagnosis are found to occur much more frequently than was previously supposed. The present report comprises a series of 25 cases observed at the Boston City Hospital.

The roentgen and clinical manifestations of diverticulosis of the small intestine are described.

An unusually high incidence of diverticula elsewhere in the gastro-intestinal tract and also of esophageal hiatus hernia was found in our series.

If the clinician is not aware of the presence of the diverticula, the patient may be subjected to long periods of unnecessary medical treatment and needless surgery, or be dubbed a neurotic.

The responsibility for the diagnosis of diverticulosis of the small intestine rests practically solely in the hands of the roentgenologist.

Careful observations of the entire small bowel are essential for the demonstration of the diverticula.

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DISCUSSION

(Papers by Kautz, Lisa, and Kraft, and by Ritvo and Votta)

Ross Golden, M.D. (New York): At our institution the x-ray examination of the infant is done by Dr. John Caffey, in the Babies' Hospital. Therefore, I know little about duodenal obstruction and will not attempt to discuss it. However, I would like to point out that in two cases I have seen, the obstruction at the junction of the first and second portions of the duodenum was due to an extrinsic peritoneal band which in one instance caused the death of the patient and in an-

other instance was relieved by a timely operation.

Dr. Ritvo's presentation leaves little to discuss. I would like to point out, however, that in my experience the symptoms which he has mentioned as associated with diverticulosis of the small intestine are rather non-specific and I just wonder how far we ought to go in attributing them to, or associating them with, the diverticulosis. His warning that other disease may exist along with the diverticula I think is very timely. He spoke in an etiological sense about a possible relation between constipation and the development of these diverticula. I don't quite understand how constipation, which is a disorder of the large intestine, would manifest itself by producing a diverticulum in the upper part of the small intestine, because there is too much flexible wall of intestine to take up variations of pressure in between. In the cases I have seen there has been no evidence of back pressure in the way of delayed passage of barium or otherwise which one could attribute to constipation.

William E. Anspach, M.D. (Chicago, Ill.). I have had experience with quite a number of the congenital lesions of the duodenum in children presented so clearly in the paper by Drs. Kautz, Lisa, and Kraft. Because of the vomiting, an obstruction is suspected, and the logic of oral administration of barium comes in question. The danger of thus completing the obstruction was emphasized in one case, in a three-year-old child who had survived without surgical intervention and then died thirty-six hours after administration of barium by mouth. This was the first demonstration of the enormous dilatation of the proximal half of the duodenum. The physician blamed the barium for the complete obstruction and I could not disagree with him. At present another child has lived eight months without surgery. It is surprising how well some of these children look, even though all of the food has to pass through a lumen often less than 2 mm. in diameter. Surgery has offered little in the cases coming our way. Nearly all have proved fatal.

If the roentgenologist will see that all chest roentgenograms of children are made in the upright position, this peculiar lesion may be discovered without the use of barium. The two large typical gas pockets (duodenum and stomach) usually have accompanying fluid levels. These were beautifully illustrated in 4 of Dr. Kraft's 6 cases. This is the most common or, we might say, the garden variety of congenital atresia of the small bowel. It is well to remember that this lesion is near the upper end of the small intestine and occurs with about the same frequency as atresia in the upper third of the esophagus. While most often one finds only an atresia of the duodenum, occasionally constricted zones in other portions of the small bowel are accompanying

defects and they must be sought in all cases coming to surgery.

Lewis Gregory Cole, M.D. (White Plains, N. Y.): As for this lesion (diverticula of the small intestine) being one of recent recognition by roentgenologists, I would call attention to several elaborate articles published in the early nineteen hundreds: one by Case, which Dr. Ritvo mentions, one by Dudley Roberts and myself, and several others since then.

After the first flurry of recognizing these as a pathological entity had subsided, I believe that the consensus of opinion was that they seldom were the cause of symptoms, and that when they were present and the patient had gastro-intestinal symptoms, there was no assurance that these were due to the diverticula and, furthermore, that recognition of them frequently led to surgical intervention that all too often terminated fatally.

Since the late teens this subject has come up for discussion from time to time, often with the same trend of thought, that these should be recognized and considered as a potential cause of symptoms, perhaps requiring surgery. Finding these diverticula is like finding a four-leaf clover, if one's eyes are trained to see them. One picks so many of these up in routine roentgenological procedure that it often seems wise not to report them lest some surgeon should search for them with disastrous results. At

operation they are very difficult to find in the duodenum; they often occur in the retroperitoneal portions, and the surgeon sees no evidence whatever of them as he inspects the visible and palpable portions of the gut.

Ernest Kraft, M.D. (*closing*): In reply to Dr. Golden, we differentiate between extrinsic and intrinsic factors of duodenal obstruction. In our last case there were two factors involved. There was a peritoneal band across the duodenum, and at the same level the pathologist found also an obstructing membrane within the duodenum.

Dr. Anspaeh mentioned multiple atresia, a condition which is extremely rare. I hope he will give us a complete paper on this.

In spite of the interest in subtotal and partial stenosis I wanted particularly to emphasize the complete obstruction with alarming symptoms in the newborn immediately after the first feeding. If infants are not operated on without delay, they will go down hill very rapidly and die within a week or two. I think we roentgenologists could do a great deal of good by co-operating with surgeons and other specialists, going to the operating room and helping the surgeon find the duodenal obstruction. We may see great distention of the stomach and duodenum. Unfortunately, later on, when the infant vomits and deflation becomes complete, the surgeon may not be able to discover the obstruction.



Pellegrini-Stieda Disease¹

CAPT. DELBERT A. RUSSELL, M.C., A.U.S., and LT. COL. CHARLES D. SMITH, M.C., A.U.S.

OUT OF A SERIES of 9,218 examinations in the X-Ray Department of an Army General Hospital, we have seen 8 cases of an interesting and somewhat rare clinical entity which was first described by Pellegrini in 1905 (5) and by Stieda in 1908 (10). Since that time, this post-traumatic entity has been known as Pellegrini-Stieda disease. It might perhaps better be called post-traumatic calcification in the par-articular region of the knee.

In 1938 Pellegrini (6) reported on 767 cases found in the literature up to that time. It has been the experience of most authors, however, that the disease is much less frequent than that figure would indicate. Kulowski (4), in March 1942, was able to find only 60 cases reported in the English literature.

Köhler (3) states that the onset of calcification occurs not less than three weeks following the initial trauma, and we recently have seen a case in which films taken at the time of injury showed no calcification while a film one month later revealed the typical calcification characteristic of the disease (Figs. 1 and 2). It is also the opinion of most authors (3, 4, 9) that this process develops only in patients who give a history of trauma to the knee, and that fact has been borne out in all the cases which we have seen.

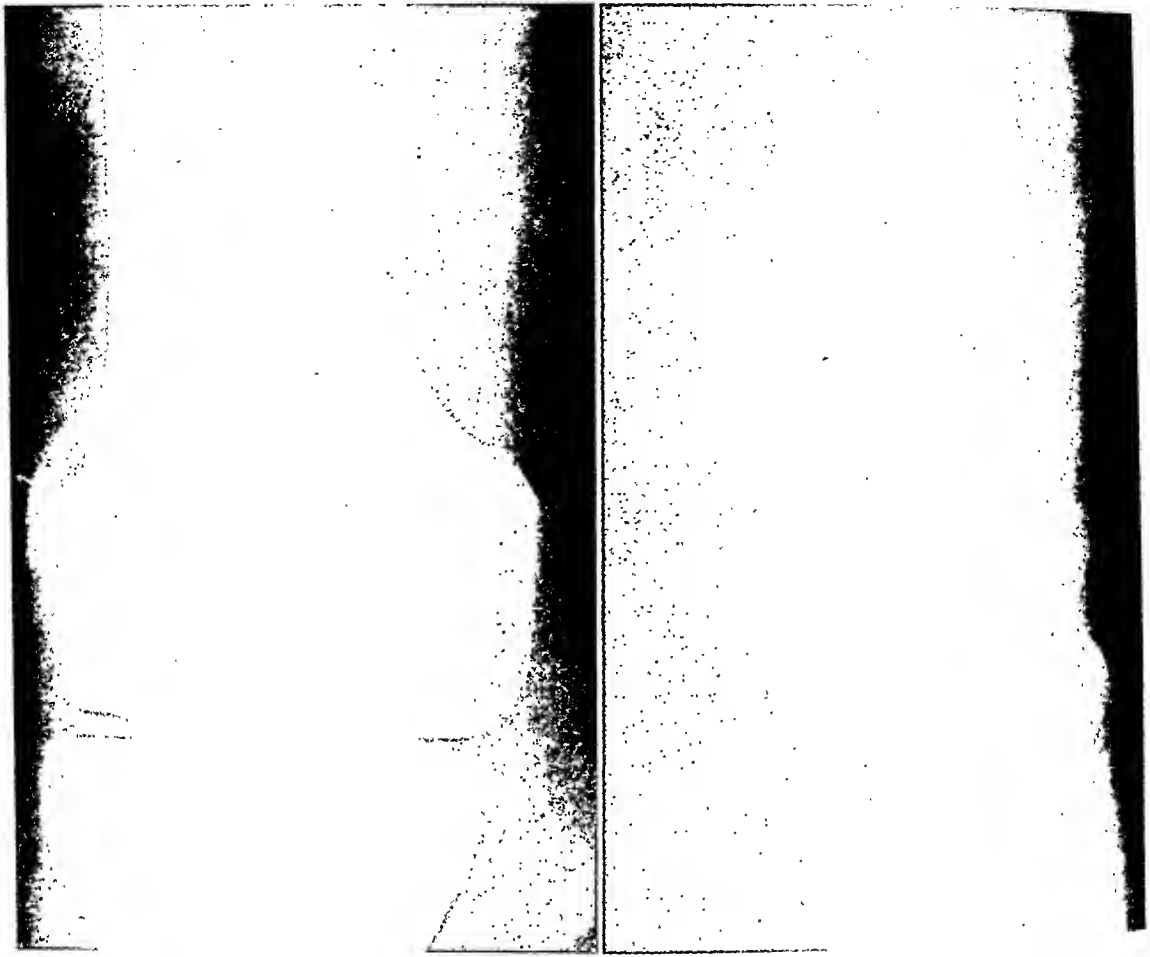
Three main theories have been developed concerning the etiology of this disease. They are: (a) separation of a bony fragment (10); (b) periosteal tear due to avulsion or tearing out of the medial collateral ligament with subsequent calcification (2); (c) development of a small hematoma within the connective tissues with subsequent calcification (7). There is, however, considerable difference of opinion in the literature as to the exact cause of the condition. Pellegrini himself (5) felt that the calcification was due to subperiosteal

hemorrhage and metaplasia of the medial collateral ligament, and we believe that this theory explains more of the findings than any of the other suggested etiological possibilities. In one of our cases (Case 1) we noted just above the medial epicondyle a small linear area of subperiosteal calcification which we interpreted as being due to periosteal tear and hemorrhage with subsequent calcification (Fig. 2). Another of our patients (Case 3) sustained a fracture of the clavicle in the African campaign, when a large G. I. truck in which he was riding overturned. This injury is mentioned here, as it showed the tendency in this individual to the deposition of calcium in the soft tissues. This tendency has been mentioned as one reason why a certain percentage of those receiving injuries to the knee go on to the development of calcification in the soft tissues while others do not.

Calcification of the medial collateral ligament is a rare affliction, occurring usually in men between the ages of twenty-five and forty years. Clinically, most cases give a history of trauma to the knee, usually occurring when it is flexed and the leg is outwardly rotated. This trauma may be of the single violent type but more often takes the form of repeated minor injuries. Most of the patients will continue to have trouble with recurring attacks of pain and/or swelling, the complaint often being, "My knee locks on me." There is usually definite tenderness over the involved area, and tension on the ligament accentuates the pain. The patient is likely to hold the involved joint in slight flexion.

The roentgenogram is the diagnostic factor in these cases, revealing a crescent-shaped area of calcification directed either vertically or obliquely in the soft tissues just medial to the inner condyle of the femur and appearing to cap the epicondyle. Characteristically, there is a clear radiolu-

¹ Accepted for publication in July 1944.



Figs. 1 and 2. Case 1. In the roentgenogram (left) taken at the time of injury no pathological changes were demonstrated. A tripartite patella is present. A roentgenogram (right) taken forty-one days later shows a soft, indistinct calcific shadow capping the medial epicondyle. There is also subperiosteal calcification just proximal to the condyle. This is the typical roentgen appearance of the early or evolutive phase of Pellegrini-Stieda disease.

cent space of varying degree between the shadow and the femoral condyle. Subperiosteal reaction may be seen occasionally along the inner margin of the shaft of the femur, just above the epicondyle.

Two main types of the entity are described radiologically. They are the evolutive type and the stabilized type. The evolutive type appears as a hazy or fuzzy opacification which is not clearly demarcated from the epicondyle, while in the stabilized form we see a dense, sharply outlined ossified shadow clearly separated from the epicondyle.

The treatment will vary depending on the stage of the disease and the amount of discomfort present. Surgical excision (2) should be done if the condition provokes clinical discomfort, but only after the

process has reached the stabilized form. Some cases have apparently healed spontaneously (9). Lately, x-ray therapy has been tried in the acute cases (4), but no definite statement as to its value has been made.

CASE REPORTS

CASE 1: The patient, 24 years old, fell and injured his left knee on Jan. 14, 1944, jumping from a wall. The knee was immediately splinted and the patient was evacuated to the rear. The impression at that time was of an acute sprain, and roentgenograms taken at the Evacuation Hospital showed no fracture (Fig. 1). Films taken at our hospital (Fig. 2) on Feb. 25, forty-one days following the injury, showed a large crescent-shaped shadow of calcification capping the medial epicondyle of the femur, with a clear radiolucent area between this shadow and the epicondyle. A small area of periosteal elevation with subperiosteal calcification was also present, just proximal to the epicondyle. There

was a tripartite patella. The film of the opposite knee was negative.

CASE 2: A man 32 years of age fell from a truck in January 1943, injuring his knee. The knee was swollen and painful for several weeks and the patient received physiotherapy. A second injury to the same knee was sustained in April 1943, and recurrent attacks of pain and swelling followed.



Fig. 3. Case 2. Roentgenogram showing the typical calcific shadow capping the medial condyle, roughening of the periosteum just proximal to the condyle, and atrophy of disuse. The dense crescent-shaped calcific shadow capping the medial condyle, and clearly separated from it, is characteristic of the late or stabilized form of Pellegrini-Stieda disease.

On May 1, 1943, a medial meniscectomy was done. The patient entered our hospital the latter part of June 1943, stating that his knee had been weak ever since the operation. A film made in July (Fig. 3) showed the typical dense, crescent-shaped area of calcification capping the medial epicondyle plus very minute roughening of the periosteum above the epicondyle. There was also interosseous bone production and some atrophy of disuse about the knee. These additional changes may well be the result of the previous operation.

CASE 3. The patient, a man of 21, injured his



Fig. 4. Case 3. Roentgenogram of the affected knee showing the dense crescent-shaped calcific shadow along the medial margin of the medial condyle.

right knee while playing football, in the fall of 1940, and had experienced intermittent attacks of pain and locking of the knee ever since. Physical examination showed slight tenderness along the margin of both sides of the knee joint. Roentgenograms (Fig. 4) taken in July 1943 showed the typical dense, sharply outlined, crescent-shaped calcific mass overlying the medial epicondyle. A film of the right shoulder, made two weeks following a fracture of the clavicle sustained in the African campaign, showed roughening and irregularity of the distal ends of the clavicle. The most striking thing, however, was the bizarre appearing calcific mass extending between the clavicle and scapula, which had apparently developed fairly rapidly following the injury.

CASE 4: A man of 25 years, admitted to our hospital for dislocation of the left knee, gave a history of injury while playing football in 1936. He had experienced recurring dislocation of the knee since that time. X-ray examination showed slight narrowing of the joint space along the medial half of the knee. There was also demonstrated the typical crescent-shaped calcific area capping the medial epicondyle and separated from it by a well demarcated area of decreased density.



Fig. 5. Case 6. Roentgenogram showing the crescent-shaped area of calcification capping the medial condyle, indistinctly outlined in this case.

CASE 5: A man of 27 years sustained a dislocation of the left knee in December 1936, in an automobile accident, and had suffered from frequent attacks of pain and locking of the knee since that time. Roentgenographic examination showed early hypertrophic changes and also the typical crescent-shaped calcification of Pellegrini-Stieda disease.

CASE 6: A 30-year-old soldier injured his knee in April 1943, jumping in a foxhole during the African campaign. He was treated for sprain, but the knee continued to bother him. He was admitted to our hospital in July 1943, because of the sprain. On admission, the knee was moderately painful and the patient seemed to hold it in partial flexion. X-ray examination (Fig. 5) showed the characteristic crescent-shaped area of calcification capping the medial epicondyle. This area of calcification was not sharply outlined, and the radiolucent area usually well shown between the calcific mass and epicondyle was hazy in appearance and poorly defined.

CASE 7: A man of 24 years had injured his left knee playing football in 1937 and complained of recurring attacks of pain and giving way of the

knee since that time. Here-injured the knee jumping out of a half-truck during the Tunisian campaign. On admission to our hospital, there were limitation of flexion and slight pain over the medial side of the knee. An x-ray examination (Fig. 6) showed a somewhat vermiform area of calcification along the border of the medial epicondyle and extending obliquely across the superior border of the epicondyle.



Fig. 6. Case 7. Roentgenogram showing a small oblong area of calcification in close proximity to the proximal portion of the medial condyle of the femur.

CASE 8: The patient was a man of 21 years. In March 1943, while prying loose some rocks with a pick, he slipped and fell on his left knee. The knee was swollen and painful for one week, after which the pain and swelling subsided, but the patient continued to note a "grating" sound whenever the knee was flexed. He was inducted into the army and was able to complete basic training but was given light duty because of recurring attacks of pain and swelling of the knee. The x-ray showed a fusiform area of calcification overlying the medial epicondyle with a clear radiolucent area between the calcific area and the femoral condyle. An oblong area of calcification was observed in the posterior region of the knee joint just above the posterior margin of the tibia. There was an os fabella present.

There was also a linear patchy appearing area of calcification in the region of the suprapatellar bursa.

CONCLUSIONS

1. Eight cases of Pellegrini-Stieda disease are added to those in the literature.
2. All cases studied showed a characteristic roentgen appearance, namely, a crescent-shaped area of calcification capping the medial condyle of the femur.
3. A tendency to deposition of calcium in other parts of the body was observed in two of the cases.
4. Evidence of subperiosteal tear and subsequent calcification was noted in one case.
5. All cases studied gave a history of previous trauma to the knee.

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Spondylolisthesis

Further Remarks with Emphasis on Radiologic Aspects¹

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THE SCOPE OF this article is supplementary. It is intended to reaffirm most of the cardinal roentgen criteria for the diagnosis of prespondylolisthesis and spondylolisthesis described in detail in a previous publication (1). It is also intended to correct or modify some earlier impressions, as well as to add a few new observations.

Our findings, as originally noted, were based on 15 cases. Since then, an additional 55 cases have been collected, bringing the total to 70 at this writing. The following statistical, radiologic, and clinical comments are based on a study of the complete series. For purposes of brevity and economy, additional illustrations are not included at this time, particularly since the radiographic demonstration of the classical defect, with which we are chiefly concerned, was adequately covered in the original communication.

DEFINITION

Spondylolisthesis is a forward or anterior displacement of the spine because of the presence of an osseous defect in the posterior neural arch. More specifically, the defect is found in the pars interarticularis or isthmus, *i.e.*, that portion of the neural arch where the lamina, the superior articular process, the inferior articular process, and the pedicle meet. This defect is bilateral, and the forward slipping of the spine occurs slowly, increasing progressively as multiple minimal traumata are added upon a mechanically weak back. This forward slipping occurs at the point immediately above and anterior to the site of the defect.

Prespondylolisthesis is the term used to signify merely the presence of the defect described above. This defect may be either unilateral or bilateral, whereas in

spondylolisthesis it is almost always bilateral. This is one distinction between the two lesions. More important is the fact that in prespondylolisthesis there is no forward slipping of the vertebra, merely the presence of a defect in the isthmus. bilateral or unilateral, the former predominating. Spondylolysis is a synonymous descriptive term, but we prefer to speak of prespondylolisthesis and spondylolisthesis because of the obvious relationship of the two words, the former referring to the presence of a defect without slipping, the latter to the added condition of forward slipping. For further convenience in description, the extent of forward displacement is referred to as first, second, third, or fourth grade, depending on where the posterior surface of the adjacent lower vertebra lies with respect to the posterior inferior angle of the vertebra involved. First grade would represent the minimum and fourth grade the maximum degree of forward slipping.

GENESIS

The time of origin and reason for occurrence of the isthmus defect are still a controversial subject. Both sides present good arguments in favor of their views as to whether the lesion is congenital or acquired. Most orthopedic men hold to the congenital origin. We feel, as originally and more fully expressed, that the work of Hitchcock (2) merits serious consideration. The defect is found in an area abounding with developmental anomalies. Hitchcock has indicated that the center of ossification for the formation and growth of each side of the posterior neural arch lies in the pars interarticularis. It has also been shown that the isthmus area is occupied by blood vessels almost sinusoidal in structure, which structurally weakens this zone. These factors lead us to believe that in a

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certain percentage of individuals the isthmic area is developmentally weak, and that superimposed trauma occurring anywhere from birth to several years later results in interference with complete solid ossification. Hitchcock describes the isthmic region as remaining cartilaginous up to and after birth, so that traumata incurred at birth or later could interfere with ossification. The absence of callus in the face of trauma as a cause is no argument against the above thesis, as we feel that a vascular disturbance occurs which, in view of lack of immobilization, is never corrected. Hence no osseous union. This view is confirmed in part by the appearance of some of the defects, which suggests the presence of an osteochondritis. In these cases, fragmentation, sclerosis, and lack of union may be seen. In other cases, where the defect is smooth and clean-cut, the explanation is comparable to what occurs in fractures where immobilization has been inadequate, so that delicate blood vessels striving to cross the site of the defect meet an impenetrable fibrous barrier.

On the other hand, we feel strongly that trauma *per se* is not the entire explanation. A sound isthmus, even though subjected to the most severe type of injury, resulting in comminuted fractures of the vertebral body, has never been seen to be disturbed. The body of the vertebra, the transverse processes, the inferior and superior articular processes, and even the spinous process may be fractured, but the isthmic portion remains unscathed if it is structurally sound to begin with. Our conclusion, therefore, is that one must have an inherently weak isthmus (developmental factor) *plus* trauma, either single or repeated, to produce the classical defect. The weight of the evidence so far presented must lead to this conclusion as the most logical one.

INCIDENCE

The literature places the incidence of spondylolisthesis at approximately 5 per cent. This figure was duplicated in the examination of 100 soldiers selected because of complete lack of back symptoms (M.

Freedman). Our figures are as follows: 811 radiographic examinations directed to the lumbar and sacral areas of the spine revealed 70 cases, approximately 8.5 per cent, with irrefutable roentgen evidence of prespondylolisthesis and spondylolisthesis. An analysis of the findings is indicated in Table I. Fifteen additional cases were

TABLE I: TYPE OF LESION FOUND, ITS LOCATION AND FREQUENCY

Examinations	—Prespondylolisthesis—		Spondylolisthesis
	Unilateral	Bilateral	
811	5th L. V. (2)	5th L. V. (18)	5th L. V. (46)
	4th L. V. (0)	4th L. V. (1)	4th L. V. (3)

finally discarded because the findings were not definite enough from the radiographic standpoint. We tried to adhere rigidly to the roentgen criteria essential to the diagnosis, but we feel that a certain number of these discarded cases represented atypical forms of the lesion or lesions which could not be adequately demonstrated. If this assumption is admissible, the incidence would be much closer to 10 per cent, as we have from the beginning contended to be the case.

Our explanation for this higher rate of incidence is as follows. In part, it may be attributed to the fact that we are dealing solely with the age group most apt to reveal this lesion. To this is to be added the factor of violent exercise and trauma so much the part of a soldier's life. We also believe that a thorough concept of the anatomy of the part involved and a sound knowledge of how to demonstrate the defect radiographically must result in the detection of a number of cases that would otherwise escape unnoticed. To confirm further the correctness of this statement we present Table II. Here it will be seen that radiographic study especially designed to demonstrate the defect revealed by far the highest number of positive findings.

It may be apropos at this time to comment upon the fact that a rate of incidence is not merely a matter of cases studied divided by the number of positive cases

TABLE II: ANALYSIS OF THE PART SUSPECTED OF PATHEMA, THE NUMBER OF EXAMINATIONS, AND THE NUMBER OF LESIONS, WITH LIST OF ERRONEOUS DIAGNOSES

Type of Examination Requested	No. of Such Examinations	No. of Lesions	Clinical Diagnoses Ventured
Lumbar spine	270	3	Low back pain
Sacroiliacs	46	5	Sprain-strain
Lumbosacral junction	230	20	Infection
Routine low back	265	42	Spondylolisthesis
Total	811	70	Fracture
			Arthritis
			Herniation of nucleus pulposus

found. For example, the lumbar spine, sacroiliac, and lumbosacral junction studies made consisted of the conventional antero-posterior and lateral views. The sacroiliac views consisted in the main of a single 14 X 17-in. film including the pelvis and hip regions. Obviously these studies are not to be considered exhaustive in any sense of the word. They are barely acceptable. Examinations of this type numbered 546 and yielded only 28 cases, or slightly more than 5 per cent. When, however, x-ray studies ordered for the express purpose of bringing to light an elusive defect were made, the incidence was much higher, namely, 42 positive cases out of a total of 265 studies, or 17 per cent. From this analysis it is interesting to speculate as to how many more positive findings would have resulted had the entire 811 examinations been routine low back studies. Obviously, the question of the accuracy and thoroughness of the method employed in arriving at a diagnosis must have considerable bearing upon the numerator of our statistical fraction.

The mechanics involved in spondylolisthesis will not be considered at this time, as this phase of the subject was previously dealt with. For emphasis, the more obtuse the lumbosacral angle, or the more horizontal the position assumed by the sacrum, the greater the tendency toward slipping in the presence of a bilateral defect. Incidentally, we determine the lumbosacral angle by dropping a vertical line through the centers of the lumbar ver-

tebrae and a similar line through the center of the long axis of the sacrum. At the junction of these two lines the angle is observed, *anteriorly*, not posteriorly. This observation is made because of the confusion created by complicated drawings we have seen purporting to explain how this angle may be calculated.

SYMPTOMS

Curiously enough, the degree of anterior or forward displacement is not always directly proportional to the extent of the symptomatology. Persons with third- and fourth-grade spondylolisthesis may go about their work oblivious of their defective spines, while a person with a pre-spondylolisthesis or a first-grade spondylolisthesis may have considerable low back pain. This situation is somewhat comparable to the presence of pain in the case of a small osteophyte of a lumbar vertebra and complete absence of pain in a case showing extensive spur formation with bridging.

Subjectively, low back pain is the most common complaint. This varies considerably as to type, intensity, location, and distribution. It may be constant or only actuated by excessive motion or strain at the lumbosacral junction. It may be localized to the back or radiate to the hip or coccyx or show a sciatic type of distribution. Relief in the recumbent position is a common story. Tenderness over the spinous process, with muscle spasm, may be present, but is not usual in cases without a history of recent injury or sudden strong exertion or torsional movement. We have seen little evidence of dorsal root compression, paresthesias, or disturbed reflexes, and one often wonders how this can be in those advanced cases where the inferior articular surface of the fifth lumbar vertebra is compressed against the anterior surface of the first sacral segment and the disk is completely disrupted. There may be limitation of flexion, extension, or lateral motion with or without spasm. Quite recently Gianturco (3) has suggested a method of analysis of the motion factor

of the lower lumbar vertebrae in patients with low back pain. This method may present possibilities for more accurate determination of actual disability. There may be an exaggeration of the lower lumbar curve or a loss of the normal lumbar lordosis.

The clinical picture is obviously vague and unreliable as an aid toward the correct diagnosis. To substantiate this, Table II lists some of the more common clinical diagnoses made. In only 21 of the 811 cases was the clinical diagnosis prespondylolisthesis or spondylolisthesis, and of these only half were confirmed by roentgen examination. It is apparent, therefore, that the diagnosis of these two allied conditions rests with the radiologist.

DIAGNOSIS

We have stated elsewhere and repeat that a thorough knowledge of the anatomy of the lumbosacral area is essential. One can almost, but not quite, master this phase of the subject by reading about it. A far better method is to acquire an articulated pelvis and lumbar spine. Using this as a model, radiographs should be made in the following projections: anteroposterior, anteroposterior with the central ray directed 35 degrees cephalad, right and left oblique, and lateral. In all of these studies the fifth lumbar vertebra and the first sacral segment should receive the central ray. If there is any doubt as to the proper identification of superimposed parts, the process should be repeated with the use of lead numbers to identify the parts in question. After this has been done to satisfaction, the defect may be simulated by cutting or sawing through the isthmus on one side. This cut should traverse the long axis of the isthmus so that the medial portion will be slightly more cephalad than the lateral end. The above described views should then be repeated so that one may become thoroughly familiar with the appearance of a unilateral prespondylolisthesis, for this is the lesion that has been created. To reproduce a bilateral prespondylolisthesis a similar cut should be made in the same region on the sound side and the views should again be repeated. True, this is a laborious procedure but well worth the trouble, as the radiographic interpretation of lumbosacral lesions is not easy at best. Frequent and variable congenital anomalies in this area add to the difficulty.

Time and considerably more material than the 15 cases which formed the basis for our original report (1) have convinced us of the soundness of the roentgen criteria based on the demonstration of the defect by the use of six views. These are as above described, plus a lateral view taken with the patient erect. This view is of no particular value other than to demonstrate the increase in the lumbosacral angle incidental to the erect position. It is sometimes a graphic demonstration of how little actual support the inferior surface of the fifth lumbar vertebra derives from the superior surface of the first sacral segment. The less the support, the greater the shearing forces exerted at this junction and the greater the call made upon surrounding muscular and ligamentous structures for aid in support.

The straight anteroposterior view may or may not demonstrate the defect. We have made the statement elsewhere that more of these lesions could be detected if the defect were searched for in radiographs of the abdomen taken for other reasons than a spine study. In these films a scrutiny of the region immediately below the pedicles will occasionally be rewarded by a suggestive defect zone. This is not always the case, for sometimes, even after finding the defect in the more revealing views, we have returned to the anteroposterior view and still have not been able to demonstrate it to our satisfaction. The usual explanation for this is the excessive superimposition of osseous structures commonly seen in the region of the fifth lumbar vertebra and the first sacral segment.

Often, when the defect could not be seen in the anteroposterior view, the angle anteroposterior view has been of great value. Here, by virtue of distorting or ex-

aggerating the length of the inferior articular processes, we have been able to see more of them as it were, and so find the defect. It may be said, therefore, that the conventional anteroposterior and the angle anteroposterior views (35-degree tilt cephalad of central ray) more or less complement each other.

Occasionally the zone of linear translucency which represents the osseous defect may be transversely directed, and in some instances the medial end of the line may be lower than the lateral end. This is somewhat difficult to explain, for it will be noted that the isthmus is directed upward, medially, and anteriorly in its upper portion, and downward, laterally, and posteriorly in its lower or more dependent portion. The defect line must of necessity be directed the same way, for it will be noted that the pars interarticularis of the fifth lumbar vertebra is compressed as compared to the same area of higher vertebrae, and if the lamina is to be avoided the medial end of the defect line is almost always forced to lie more cephalad than the lateral end. In those instances in which the medial end of the defect line appears to lie lower than the lateral end we feel that the vertical diameter of the isthmus is greater than usual. It thus becomes possible for the defect to lie high enough so that the medial end may be slightly lower than the lateral portion of the defect and still clear the lamina. An apparent paradox is occasionally seen in which the conventional anteroposterior view will definitely indicate this to be the case and yet the angle anteroposterior view will reveal that the medial end of the defect is slightly higher than the lateral end. This angle anteroposterior view is also of great value in differentiating the medial end of the defect line from the medial side of the apophyseal joint space. The medialmost portion of the defect line never dips downward, whereas the same area of the joint space always shows a caudad inclination. In short, the angle anteroposterior view is of great help because, by virtue of projection, it serves to separate structures

which are superimposed in the conventional anteroposterior view. In addition, the true width and appearance of the joint space between the fifth lumbar vertebra and the first sacral segment are revealed.

The oblique studies are probably the most valuable of all, since they serve to separate the isthmus from most other structures. We have used the expression "bow-tie" to describe this crucial zone. The upper portion of the tie consists of the superior articular process and the base of the transverse process slightly below and anteriorly; the lower portion consists of the inferior articular process and the lamina posterior to it. The osseous zone between these structures is constricted and represents the isthmus or pars interarticularis. The entire structure, as described above, resembles a bow tie lying in an oblique plane. The bow ties of the upper lumbar vertebrae stand out more conspicuously than those of the lower lumbar vertebrae. The former are also seen to lie nearer the vertical plane or on end, while those of the lower levels lie obliquely at about a 30- to 45-degree angle. While still not too familiar with the appearance of these bow ties, a good plan is to study those of the higher lumbar vertebrae, which stand out more clearly, then allow the eye to drop down along the others until the area of the fourth and fifth lumbar vertebrae is reached. By this time one has a good impression of them individually and comparatively so that a defect will stand out more clearly if it is present.

A common pitfall is to measure mentally the difference in densities between the inferior curve of the base of the transverse process seen on end and the isthmus area immediately below. The latter will appear to be less dense. This effect is further heightened by the greater density of the next zone as one goes on to inspect the inferior articular process. The impression may be gained that one is observing a defect. Such is not the case.

The defect line seen in the oblique views may appear as a distinct linear translucency across the isthmus, or there may be

various modifications of this appearance. The defect may be irregular and ill defined. More commonly its edges are eburnated, even though they may be irregular. Sclerotic areas or islands may be present in the isthmus with no clear-cut defect line. The isthmus is superimposed upon the upper portion of the body of the vertebra of which it is a part. This is certainly true with respect to the oblique view of the fifth lumbar vertebra; so that bone trabeculae will be seen in the isthmus area whether or not there is a defect. An obvious defect, however, will always show a localized osseous dehiscence. One way to confirm this impression is to follow the line made by the superior border or edge of the superior articular process of the fifth lumbar vertebra. This will proceed downward and posteriorly and should run continuously into the superior border or edge of the lamina. If there is an interruption at the isthmus area, a defect should be suspected. Similarly, the line of the articular surface of the inferior articular process of the fifth lumbar vertebra may be followed, in this case upward and anteriorly. If, once again, an interruption is noted at the isthmus area, a defect is probably present.

Another landmark is the summit of the superior articular process of the first sacral segment. The defect always lies a few millimeters above this point. Occasionally it will be slightly anterior, but most often lies directly above it. Quite often the superior articular process of the first sacral segment may actually appear to be jammed into the defect space or zone, thus partially hiding it. Even the inferior articular process of the vertebra above the level involved may seem to press its inferior tip into the defect site.

It must also be remembered that in obtaining an oblique view the correct degree of obliquity is important, for over- or under-rotation of 5 or 10 degrees may be sufficient to distort the bow-tie shadow and prevent visualization of the apophyseal joint spaces. In a certain number of cases, however, due to asymmetry of the joint planes, a rotation of 35 degrees on one side

may reveal the joint space while a similar rotation on the other side may fail to do so. In this case, repeat films with varying degrees of rotation must be done on the side in question before narrowing or obliteration of the joint space can be inferred.

This may be a good place to state, if the impression has not already been gathered, that roentgenographic study of the lumbosacral area is a painstaking procedure, and the amount of information gleaned from the films is often directly proportional to the thoroughness with which the study is conducted. Incidentally, the sacroiliac synchondroses may also be studied, as the joint space of the contralateral side is demonstrable, *i.e.*, the right sacroiliac joint space is neatly seen in the left oblique view of the fifth lumbar vertebra.

The lateral view is of course of irrefutable significance in cases of spondylolisthesis. Here the vertebra involved will show some degree of anterior or forward slipping. In such cases this view alone is sufficient for the diagnosis. The defect line is always found just below and behind the lower posterior inferior angle of the superimposed pedicles. It may be broad, measuring several millimeters, or may be quite narrow. The broader bands of osseous dehiscence or translucency zones are usually seen in the more advanced degrees of forward slipping. The defect line may be horizontal or, as is more often the case, slightly oblique, with its posterior portion higher than the anterior. It is extremely important that the central ray traverse the defect squarely in the same plane, or it will not be adequately demonstrated. Therefore, the defect area should be positioned as nearly as possible over the center of the film and the central ray directed to the same region. The patient must be accurately positioned if confusion and controversy are to be avoided in the viewing room. The defect line may be straight and well defined or curved. If the latter is the case, the convexity of the curve is directed cephalad. The defect may be so ill defined as merely to give the impression of a gap in the osseous structures at the point in

question. This is particularly true when there has been a slight movement of the patient or if the view is not quite a true lateral. The use of the rotating anode tube is most desirable in the study of the lumbosacral area, certainly with respect to the lateral view. "Spotting" with fully extended cone offers material advantage in the technical quality of the films thus obtained.

A review of the entire series of cases strikingly illustrates the necessity for *complete* study in every instance of a suspected defect, for, strangely enough, one can never foretell which view may reveal the defect to best advantage. In some cases the angle anteroposterior view, in others the oblique views, and often the lateral view may be the most satisfactory. We have not seen one case in which the defect, if present, could not be noted in at least one or more of the six views utilized. So firmly convinced are we of the necessity for each view that we would not want to give a final opinion without the benefit of a complete low back study.

We have noted in several cases of spondylolisthesis that the superior articular processes of the first sacral segment are shorter or more flattened than is usually the case. A possible explanation is that this represents a developmental deficiency of these processes. In any event, the fact that they are so blunt may be a factor in the ease with which the fifth lumbar vertebra slips forward, since their usual buttress effect is decreased by virtue of their limited height. This shortening of the superior articular processes of the first sacral segment is often best noted in the angle anteroposterior view and occasionally in the lateral view, in which these structures, appropriately called "dog ears," seem very small indeed. Suffice it to say that this observation has been made often enough to offer it as a prognostic sign. When the superior articular processes of the first sacral segment are very short in a case of bilateral prespondylolisthesis, one may definitely anticipate forward slipping much sooner than would otherwise be the case. Narrow-

ing of the intervertebral disk occurs late in spondylolisthesis. It is more apt to be seen in those cases which have gone on to a second and greater degree of slipping.

Study of the lumbosacral junction with particular reference to the occurrence of "reverse spondylolisthesis" leads us to doubt the existence of this entity. We originally were of the opinion that we had several cases illustrating this condition, but have since had reason to revise this concept. Normally, one will find that the posterior surface of the fifth lumbar vertebra may at times lie as much as 2 or 3 mm. posterior to the posterior surface of the sacrum. The incidence of this finding is approximately 1.5 per cent in our series of lateral lumbosacral films. We have come to consider it a normal variation. To produce a true reverse spondylolisthesis there must be a defect in the posterior neural arch somewhere between the inferior articular processes and the attachment of the pedicles to the body of the vertebra, or one should be able to demonstrate some widening of the apophyseal joint spaces. In short, it is an anatomical impossibility for a true posterior displacement of a vertebra to occur without some derangement of the posterior neural arch resulting. We have never been able to demonstrate such a derangement in our suspected cases.

SUMMARY

Attention is once more directed to the greater prevalence of prespondylolisthesis and spondylolisthesis than is ordinarily anticipated. The clinical and medicolegal significance of the successful demonstration of either of these conditions should be obvious. It is strongly recommended that a *complete* radiographic study be made in all patients with low back complaints. This should include at least five of the six views recommended and the films must be of good technical quality. The necessity for insistence upon such thoroughness is substantiated by a comparison of the number of positive findings when the complete study is done with the number of

similar findings when only the conventional two views are taken. Furthermore, since the clinical diagnosis, when ventured, is little better than one of many possibilities, the final diagnosis rests with the radiologist. In view of all this, we have been prompted to reanalyze our series in the hope that the radiologist's acumen along these lines may be sharpened. Some details revealed by the various views have therefore been presented.

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Energy Absorption in the Trunk in the Radium Treatment of Breast Cancer by Interstitial and Surface Applicator Methods¹

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FOLLOWING THE original work of Grimmett (5, 6), Mayneord (13), and Hap-
pey (7, 8), a considerable number of papers
have appeared dealing with both the
physical and clinical aspects of the total
energy absorbed throughout the body dur-
ing roentgen-ray and radium treatment
(3, 9, 14, 15, 16, 18). As Ellis (3) has re-
marked, knowledge of the total energy ab-
sorbed (*i.e.*, volume dose or integral dose)
may be useful in several ways, namely:

"(1) To compare the total energy ab-
sorption for various radiation techniques
in individual cases with a view to choosing
one technique in preference to another. . . .

"(2) To decide what is the threshold
constitutional dose which should not be
exceeded by any technique.

"(3) To provide fundamental data re-
lating the biological effects to the total
energy absorption."

In order that this knowledge be avail-
able in such a form that it may have these
uses, detailed investigations of integral
dose for the various techniques of radia-
tion therapy are necessary. Some data
of this kind have been reported (3, 14, 18)
for some roentgen-ray techniques, for tele-
radium therapy of the larynx, pharynx,
floor of the mouth, and tongue (1), and for
treatment of the oesophagus by a radium
bougie (12). Bush (1), indeed, was able to
relate the integral dose to the proportion of
lymphocytes found to survive when regular
blood counts were made throughout the
treatment.

The recent work of Mayneord (16) on
the mathematical theory of integral dose
in radium therapy has indicated the
methods which may be adopted in order to
calculate integral doses for the various
techniques of radium therapy other than
beam therapy. Being considerably inter-

ested in the energy absorbed in the treat-
ment of breast cancer by interstitial and
surface applicator radium techniques, we
have used the methods suggested by May-
neord to calculate integral dose in the trunk
for conditions which seem appropriate to
these techniques. Further, we have at-
tempted to relate some published data (4)
on the reaction of the lymphocytes dur-
ing interstitial radium therapy to the
integral dose received by the trunk. The
purpose of this paper is to present the re-
sults of these calculations.

PHYSICAL BASIS OF CALCULATIONS

The real energy conversion when a dose
of 1 roentgen is delivered to 1 gram of air is
a convenient first approximation to energy
absorption in soft tissues, and this quan-
tity is referred to as a gram-roentgen (13).
If dose is integrated throughout a given
volume or mass, the energy absorbed will
be determined in gram-roentgens; this
quantity is referred to as the integral dose
or volume dose. For clinical use, the gram-
roentgen proves to be rather small and
the megagram-roentgen (one million gram-
roentgens) is rather more convenient.
A megagram-roentgen is approximately
equivalent to 2 gram calories (13).

In order to keep the calculations within
reasonable bounds of simplicity, we have
followed Mayneord (16) and assumed the
trunk to be a circular cylinder of radius
13.5 cm. This value makes the area of
cross section equal to that of an ellipse of
semi-axes 10 and 18 cm., respectively.
The ellipse would be a closer approxima-
tion to the true shape of the trunk but
would render the calculations extremely
difficult, and the results, when obtained,
would not be so generally useful. From
calculations made more rigorously for a
special case (12), it appears that the errors

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due to this simplification are not large. We have also assumed the trunk to have an average length of 60 cm.

In the techniques we shall consider, it would seem that the integral dose in the trunk may not be very different from that for the whole body. The integral dose in the head and neck will not be very great because of their small volume relative to

sion the integral dose may be calculated for the complete cylinder for any position of the radium.

If b is on the axis, so that $b = 0$, the relation reduces to

$$d\Sigma = 8.3\pi \cdot \log_e \left(1 + \frac{a^2}{x^2} \right) \cdot dx \quad (2)$$

and if $d = 0$ (i.e., P is at the end of the

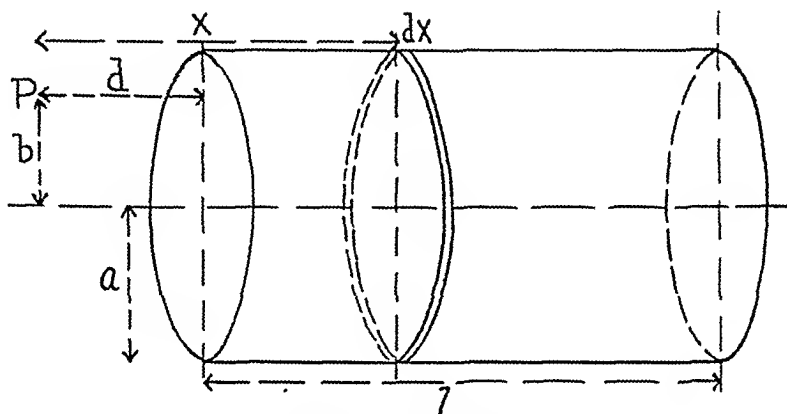


Fig. 1. P . Point source of radium b cm. from axis of cylinder l cm. long and a cm. radius.

that of the trunk. The lower limbs have a considerable volume but will not add much to the integral dose because of their distance from the radium. It is likely that the integral dose in the arms forms a considerable proportion of the total because of their proximity to the radium, but because of their indefinite position it is difficult to allow for this. In view of the kind of general reaction of the patient to integral dose in which one is interested, it seems likely that the integral dose in the trunk is the most important.

Consider a point source of radium filtered by a spherical shell of platinum 0.5 mm. thick, situated at a point P at a distance of b cm. from the axis of a cylinder of length l and radius a cm. (Fig. 1).

The integral dose $d\Sigma$ in the disc element of thickness dx is (16):

$$d\Sigma = 8.3\pi \times \log_e \frac{a^2 - b^2 + x^2 + \sqrt{(a^2 - b^2 + x^2)^2 + 4b^2x^2}}{2x^2} \cdot dx \quad (1)$$

and by graphical integration of this expres-

cylinder), the integral dose for the whole cylinder is

$$\Sigma = 8.3\pi \left[l \cdot \log_e \left(1 + \frac{a^2}{l^2} \right) + 2a \tan^{-1} \left(\frac{l}{a} \right) \right] \quad (3)$$

Calculations made by these formulae yield estimates which are probably too high, because no allowance is made for absorption of radiation by the tissues (and also, possibly, by reason of screening of one source by another in actual practice of the interstitial method). In general, however, the absorption is relatively small.

RESULTS OF CALCULATIONS

Using the above formulae we have calculated the integral dose in the specified cylinder for a variety of positions of P . The results are summarised in Figures 2A and 2B.

Fig. 2 A, shows, for various values of b , the variation of integral dose (in gram-roentgens per mg. hour) with distance from the end of the cylinder, measured toward the centre of the cylinder. Since

the half-length of the cylinder is 30 cm., the curves provide the data for radium at any position along the whole length of the cylinder. A curve is given for radium situated on the cylinder axis and also for a number of values of b such that the radium is 10, 12.5, 13.5, 14.5, 15.5, 16.5, and 17.5 cm., respectively, from the axis. When $b = 13.5$ cm., the curve corresponds to

sion fewer values of b are shown. It may be seen how rapidly the integral dose in the trunk falls off as the radium is removed from the trunk. As the distance d approaches 30 cm. or more, the value of b has little effect on the integral dose value, which is to be expected.

It is interesting, as a side issue, to use Fig. 2B in order to compare the integral

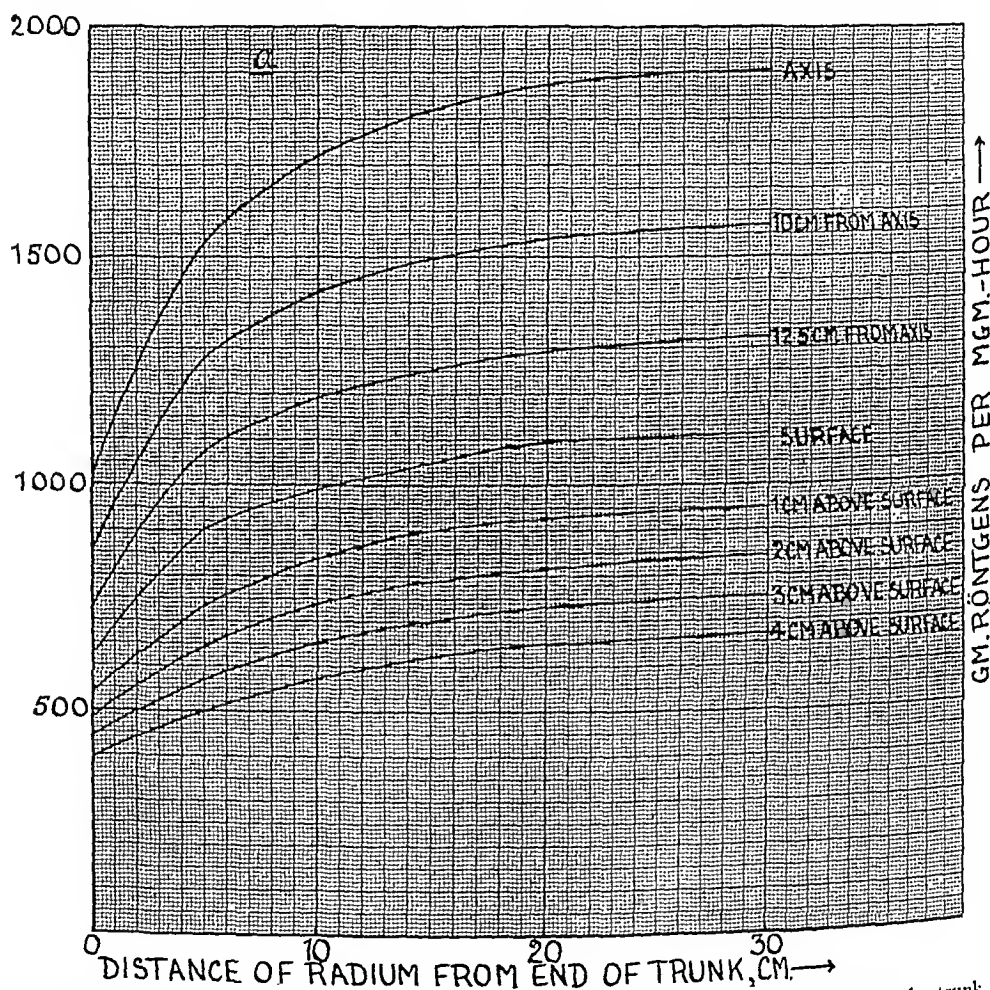


Fig. 2A. Variation of integral dose per mg. hr. with positions of radium along the trunk.

radium on the surface of the cylinder; $b = 17.5$ cm., corresponds to radium distributed on a surface applicator having 4-cm. radium-skin distance, and so on. From these graphs, interpolating when necessary, it is possible to determine the integral dose in the trunk due to radium situated at any position along its length.

Fig. 2B gives similar data when P is beyond the cylinder, that is when d has values from 0 to 30 cm.; to avoid confu-

dose due to absorption in the trunk with that due to the more local absorption in the treatment of a site located in the head. Thus, in the local irradiation of a lip, Mayneord (16) estimates that the integral dose in the head is approximately 445 gram-roentgens per mg. hr. Assuming the lip to correspond to values of $b = 8$ cm. and $d = 10$ cm., approximately, we see that the corresponding integral dose in the trunk would be of the order of 300

gram-roentgens per mg. hr. That is, the integral dose in the trunk, in this case, is a considerable fraction of the total.

APPLICATION OF RESULTS TO PRACTICAL DISTRIBUTIONS OF RADIUM

In actual practice the radium applied to the breast will not be a single source, nor will the sources be closely concentrated.

whole of the radium is concentrated at the centre of the distribution and so may deduce the integral dose from Fig. 2A for this position. The errors due to this approximation are greatest when the radium extends to the end of the trunk and when the radium covers a considerable area, but even for an area as great as 300 sq. cm. they do not amount to more than

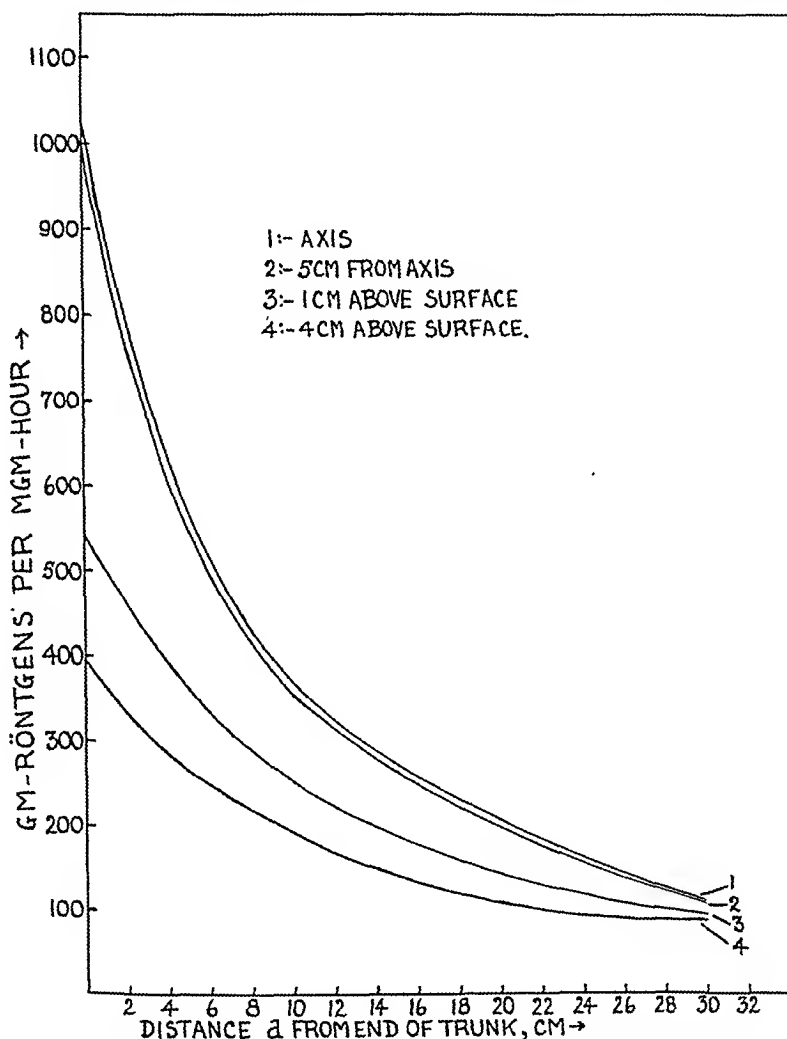


Fig. 2B. Variation of integral dose per mg. hr. with distance of radium beyond the trunk.

Common practice shows that in both interstitial and surface irradiation of the breast (2, 10, 11) the radium is usually widely distributed over a large area including the mediastinum, axilla, and supraclavicular region in addition to the breast itself.

It can be shown, however, that if the radium is distributed uniformly, one may assume, to a close approximation, that the

5 per cent (in excess of the true average value). The errors become much smaller as the radium is distributed nearer the centre of the trunk.

In the case of surface applicators on which the radium is distributed according to the Paterson and Parker methods (17), the radium is not uniformly distributed but it is symmetrically balanced and the

distance of the "centre" from the end of the trunk may be determined. It is a close enough approximation to regard all the radium as concentrated at this "centre."

In interstitial irradiation the radium may be concentrated in certain regions rather than generally distributed, *e.g.*, in the axilla, the supraclavicular area, and the breast (10). In such cases it would be

pend upon the area of the applicator and the radium-skin distance, and how it is related to the surface dose due to the applicator. For this purpose, in order to standardise the position of the applicator relative to the trunk, we have considered the centre of the applicator to lie, in each case, at 15 cm. from the end. From the position of the sites usually irradiated in

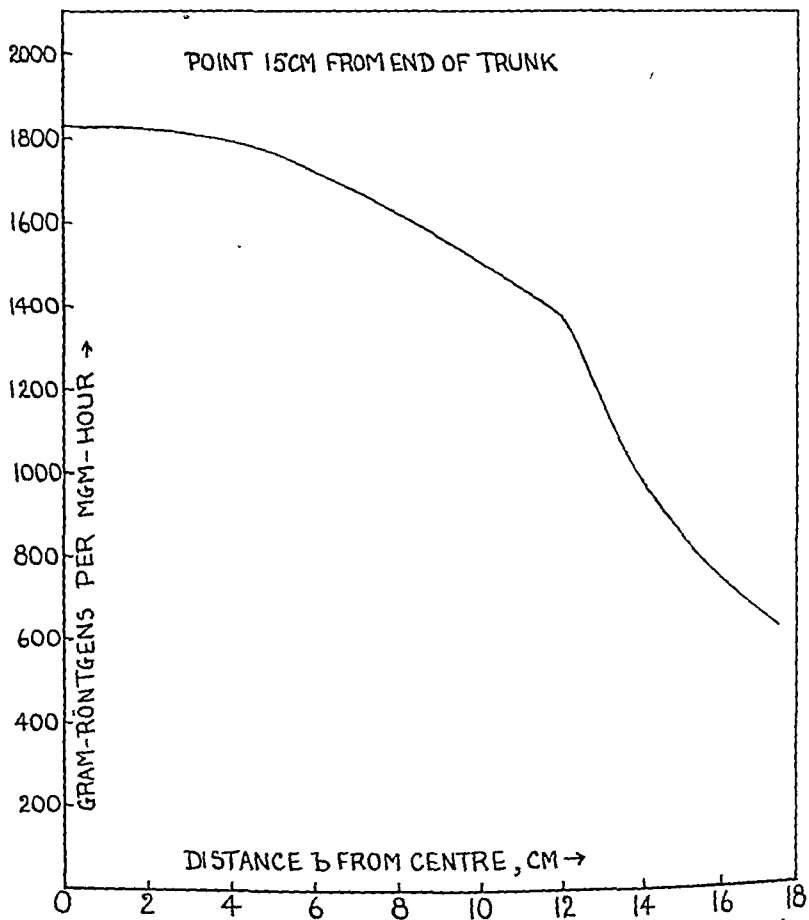


Fig. 3. Variation of integral dose per mg. hr. with distance from the axis of the trunk. Point 15 cm. along the trunk measured from its end.

more accurate to assess the integral dose for each concentration and to add the separate items.

RELATION BETWEEN TRUNK INTEGRAL DOSE, SURFACE DOSE, APPLICATOR AREA, AND RADIUM-SKIN DISTANCE IN THE SURFACE METHOD OF IRRADIATION

We have thought it of interest to examine how the integral dose in the trunk due to radium surface irradiation will de-

cancer of the breast, this value seemed reasonable. The relation between integral dose per mg. hr. and b for this distance may be deduced from Figure 2A and is shown in Figure 3.

Assuming also that the Paterson and Parker methods (17) are used for the distribution of the radium on the applicator, we may deduce a set of curves which express the relation between the integral dose per 1,000 r delivered to the

surface by the applicator and the area of the applicator, for various values of the radium-skin distance h . These are shown in Figure 4 for h values of 0.5, 1.0, 2.0, 3.0, and 4.0 cm., respectively.

It is seen from Figure 4 that if a surface dose is given of the usual magnitude (1,000–6,000 r) over a large area (say 200 sq. cm.), using, say, 4 cm. radium-skin

From Figure 2A the integral dose 10 cm. from the end of the trunk = 735 gram-roentgens per mg. hr. and integral dose 15 cm. from end of trunk = 785 gram-roentgens per mg. hr.

Megagram-roentgens per 1,000 r at a point 10 cm. from the end of the

$$\text{trunk} = \frac{735}{785} \times 4.35 = 4.07.$$

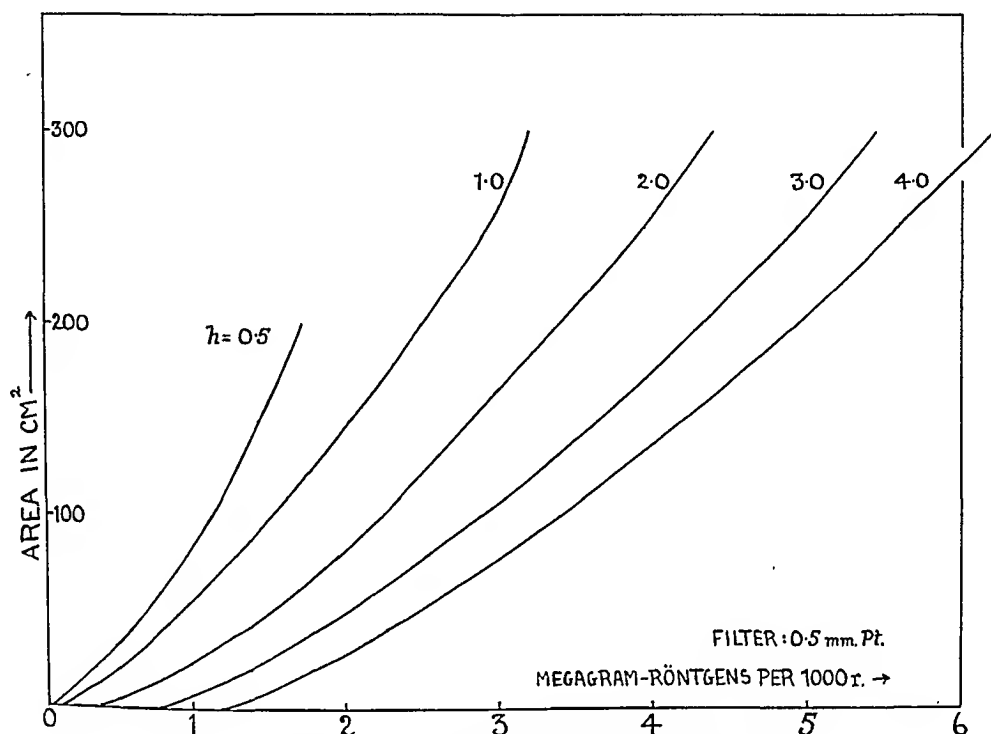


Fig. 4. Integral dose graphs for surface applicators. Center of applicator assumed 15 cm. along the trunk measured from its end.

distance, the integral dose is of the order of 25–30 megagram-roentgens, which is quite large. For larger areas the integral dose is even greater.

If, in actual practice, it happens that the centre of the radium distribution is not at 15 cm. from the end of the trunk, the curves of Figure 4 may still be used if a correction is applied by reference to Figure 2A. Suppose, for example, that the centre of a radium applicator of area 200 sq. cm. and $h = 3.0$ cm. is 10 cm. from the end of the trunk. The corresponding integral dose is found as follows:

From Figure 4, 4.35 megagram-roentgens is the integral dose for 1,000 r.

ATTEMPTED CORRELATION BETWEEN INTEGRAL DOSE AND CLINICAL EFFECTS IN INTERSTITIAL IRRADIATION OF THE BREAST

Goodfellow (4) made careful periodic blood counts on a series of 26 patients treated for carcinoma of the breast by interstitial radium, the time of irradiation being seven to eight days. In 21 of these cases the information is such that, by making certain approximating assumptions, it was possible to correlate the reaction of the blood and the integral dose.

As above, we have assumed that the "centre" of the radium distribution was 15 cm. from the end of the trunk in each case. The average depth of implantation

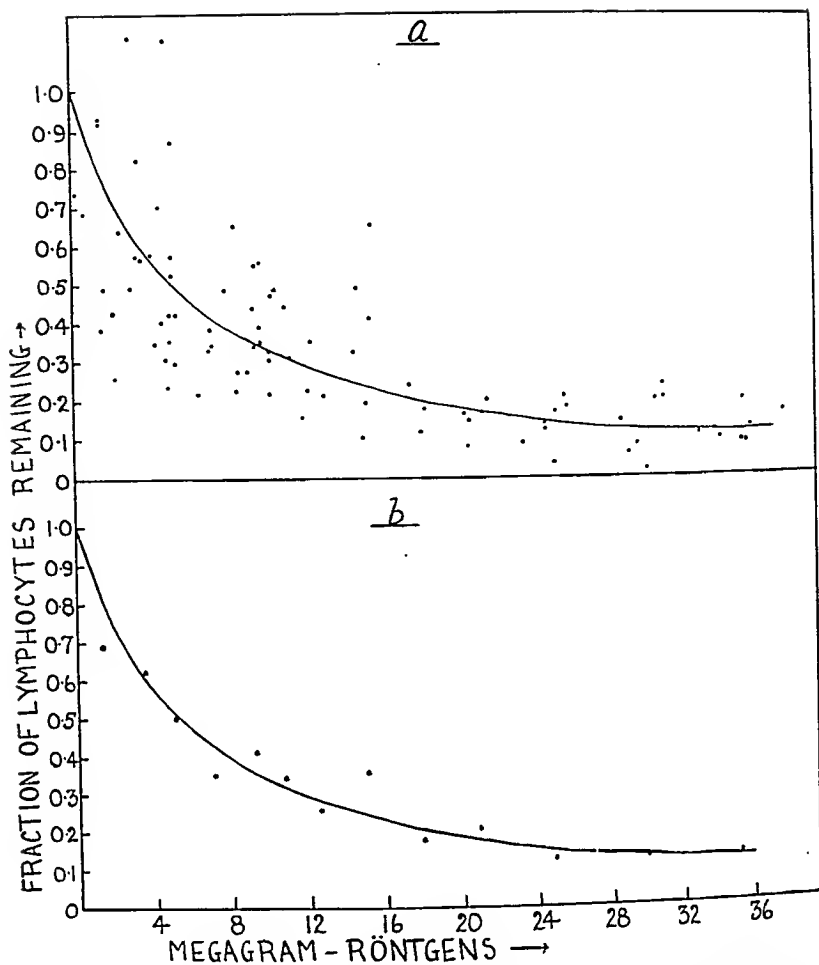


Fig. 5. *a*. Dot diagram showing correlation between integral dose in the trunk and the fraction of lymphocytes remaining. *b*. The data of *a* expressed in terms of the mean values obtained by grouping the dots.

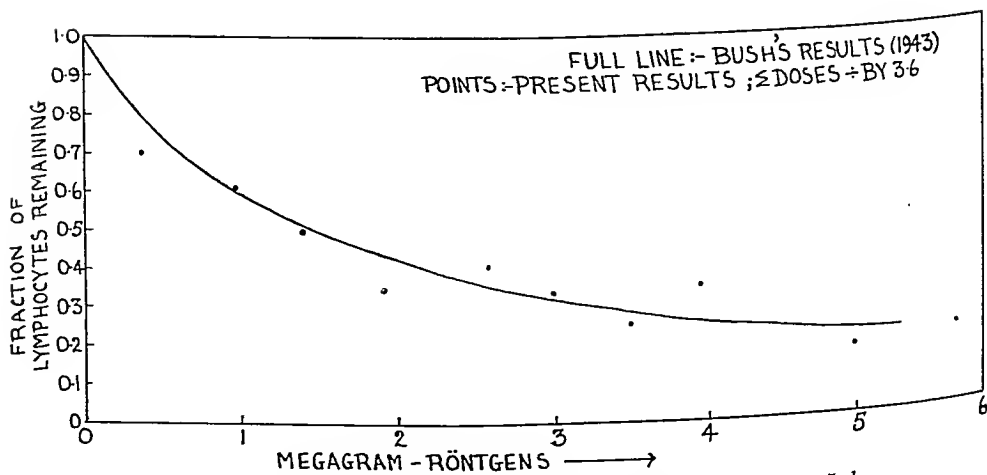


Fig. 6. Comparison of Bush's results (1) with those of Figure 5, *b*.

was given by Goodfellow, so that the average distance from the axis of the trunk was known. With these facts, the integral dose in the trunk may be calculated from the data already discussed. The values so obtained may deviate no doubt from the exact values which would be obtained from a more detailed study of each case individually, but it is hardly likely that the deviations will be so great as those found in the blood counts.

Goodfellow (4) and Bush (1) have both chosen the lymphocyte count as being the most satisfactory index of radiation effect, since it gives the most constant change and is least affected by factors such as sepsis. We have therefore expressed Goodfellow's lymphocyte counts, made throughout treatment, as a fraction of the original pre-irradiation count in each case. The integral dose corresponding to every surviving fraction of lymphocytes was calculated, and the results are shown in Figure 5, *a*, as a dot diagram.

The diagram indicates a regular behaviour, although the points are widely scattered.² The behaviour is more adequately specified in Figure 5, *b*, where the same data have been grouped so that the points represent the mean values for each group.

The relation between the fall of lymphocytes and integral dose appears to be of the same nature as that reported by Bush (1) in a study of patients treated by radium teletherapy for disease at sites in the pharynx, larynx, post-ericoid, tongue, and floor of the mouth. It differs markedly, however, in that the integral doses required to bring about proportionate biological changes are much greater in the present case. Thus Figure 6 shows as a full line the results found by Bush, and the points represent those of Figure 5, *b*, but the integral dose values have been divided by a factor of 3.6.

The differences in integral dose required

to produce equivalent effects is no doubt due to at least two factors, namely, (*a*) the difference in the region of the body being irradiated and (*b*) the difference in the dose rates and overall times used for the delivery of the radiation.

That factor *a* is important seems obvious, but it is as well to keep it in mind in attempts to relate integral dose and biological effect. It is for this reason that we have chosen only data pertaining to carcinoma of the breast from the wealth of material given by Goodfellow.

It seems to us that factor *b* is probably the most important. It is well known that dose rate is an important factor influencing biological response and that for very low dose rates radiation is usually much less efficient than for high dose rates.³ Although the integral doses studied by Bush (1) were delivered in a longer overall time they were delivered, during the actual treatment period, at very much higher average dose-rates than were the integral doses we have considered here. In some of those parts of the trunk most remote from the radium, the dose rate in the present case would be very small indeed.

The results show that it is necessary to pay the strictest attention to those other factors in any assessment of integral dose and its correlative biological effects.

SUMMARY

1. The energy absorption or integral dose in the trunk has been calculated for conditions corresponding to those of interstitial and surface radium therapy of cancer of the breast.

2. Graphs are given relating integral dose in the trunk to surface dose in the surface radium therapy of cancer of the breast. It is assumed that the radium is distributed in accordance with the Paterson and Parker methods.

3. Data concerning integral dose in the trunk during interstitial radium therapy of

² Goodfellow (4) showed a similar kind of behaviour, but at that time it was not possible to relate the dosage quantities to as precise a measure of energy absorption as integral dose.

³ See Symposium on "Dosage-Rate in Radiotherapy" by L. H. Gray, F. Ellis, G. C. Fairchild, and Edith Paterson. Brit. J. Radiol. 17:327-342, 1944.

carcinoma of the breast is correlated with the reaction of the lymphocytes.

4. It is suggested that site and dose rate are important factors in assessing the clinical importance of integral dose.

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Henoch's Purpura: Small Intestinal Changes

Case Report¹

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A DISEASE IN which there is hemorrhage in the gastro-intestinal tract, frequently associated with skin or joint involvement, has been known as Henoch's purpura, Henoch-Schönlein purpura, anaphylactoid purpura, purpura rheumatica, abdominal purpura, and sometimes as idiopathic purpura. The disease is generally considered to be a non-thrombocytopenic form of purpura, but in some cases in which abdominal symptoms have predominated there has been, also, a thrombocytopenia (1, 3). When the abdominal symptoms are unassociated with purpuric manifestations elsewhere, or when abdominal symptoms precede the skin and joint changes, the diagnosis may be difficult (2). Appendicitis, intestinal obstruction, intussusception, and ileitis are the conditions generally confused (2, 4) with Henoch's purpura, and either intussusception or obstruction may be associated with it as a complication (7, 9). Althausen, Deamer, and Kerr (1) reported 8 cases of Henoch's purpura and abdominal allergy, in 6 of which 9 operations had been done in various hospitals.

In the published reports we have found references to gastro-intestinal x-ray examinations for diagnosis of obstruction and intussusception, but no description or note of any intestinal changes. In view of the pathological process, hemorrhage in the mucosal layer, which would obliterate the normal mucosal folds and in severe cases cause separation of patches of mucosa and ulceration, roentgen examination of the intestinal tract would appear to be a valuable diagnostic aid in doubtful cases.

In the case to be reported here there was the appearance of a marked ulcerative or

destructive process in the upper jejunum, with loss of the normal pattern in the greater part of the small intestine; there was hypomotility rather than the hypermotility usually found in acute enteritis; and there was dilatation of the upper jejunum, which, associated with the mucosal changes, suggested a chronic ulcerative condition. Re-examination after three weeks showed great improvement in the intestinal pattern, and at the end of six weeks the intestinal pattern and motility were normal.

It is realized that any conclusions based on a single example may be misleading, but this case is reported as one of purpura showing extensive small intestinal damage and remarkable repair ability on the part of the small intestine.

It is suggested that x-ray studies of the small intestine may differentiate purpura from other conditions in acute abdominal cases when the diagnosis is uncertain.

CASE REPORT

H. C. A., white male, age 20, was admitted May 1, 1943, complaining of cramping abdominal pain, which had its onset three days before admission and had been of sufficient severity to interfere with sleep. For the past two days he had had frequent loose bowel movements; three stools, on the morning of admission, were said to contain bright red blood.

The family history was of no significance. Mother, father, and one sister were all living and well. The patient was born in New York State and had not been in the tropics. He had had no serious illnesses but was subject to frequent head colds. He stated that he had always had a "weak stomach" and that slight injuries, as a fall or a blow, frequently caused vomiting and diarrhea. Attacks similar to the present illness had occurred at intervals during the past eight years, but without blood in vomitus or stools. These attacks lasted two to ten days and subsided without medication. The father stated

¹ The opinions or assertions contained herein are the private ones of the writers and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large. Accepted for publication in April 1945.



Fig. 1. Roentgenogram made May 10, 1943, three and one-half hours after meal of barium suspension in water.

that during them he had occasionally noticed blood in the patient's stools. The latest attack prior to the present one was in March 1943.

The patient appeared well developed. His height was 5 ft. 4 in., weight 150 lb., temperature 100.4° F., pulse 112, respirations 24. The pharynx was moderately reddened, and there was a small amount of mucopurulent exudate on the posterior pharyngeal wall. Physical examination otherwise was essentially negative. There were no skin or joint changes. There was moderate abdominal tenderness, but no distention, no rigidity or spasm, and no palpable mass.

The red cell count was 4,220,000, hemoglobin 90 per cent, white cells 24,950 (lymphocytes 24 per cent, monocytes 1 per cent, band forms 2 per cent, eosinophils 1 per cent, segmented neutrophils 72 per cent). The Kahn test was negative. The stool showed many red blood cells but no ova or parasites. The occult blood reaction was 4 plus. The specific gravity of the urine was 1.023, with no abnormal findings.

Clinical Course: The patient vomited blood several times in the first two days in the hospital and passed several tarry stools. He was given nothing by mouth but received fluids intravenously and blood plasma; also 25 mg. thiamine chloride daily. The day-by-day observations were as follows:

May 6: Roentgen examination of the small intestine showed no evidence of obstruction. The consultant was of the opinion that surgery indicated at this time.

May 7: A barium enema study disclosed abnormality of the colon. A chest film was initially negative.

May 8: Vomiting had ceased. There was gross blood in the stools, which were still frequent. The blood plasma protein was 4.5 per cent, hemoglobin 73 per cent. The surgery was instituted.

May 9: Proctoscopic examination was satisfactory on account of a large amount of blood retracted.

May 10: A gastro-intestinal x-ray examination was done with plain barium suspension in water. The esophagus and stomach appeared normal. Gastric emptying was very slow. Serial films (1-3) showed that there was still a small residue nine hours after the barium meal. At ten and one-half hours barium was in the cecum. Eight hours had reached the rectum. There were marked changes in the small intestine. The first and second parts of the duodenum were relatively normal, but the terminal part appeared irregular, and the first part of the jejunum was dilated, with irregularities of the mucosal outline resembling small diverticula or ulcers. The dilated part of the jejunum was about 25 cm. in length; below this level some of the loops were of normal diameter, with others apparently decreased in size, with no normal mucosal pattern visible. The impression was that of a chronic process with dilatation and ulceration of the upper jejunum.

May 13: Hemoglobin was 60 per cent; white blood cell count 12,150 (84 per cent segmented). Stool cultures had been negative for dysentery bacilli; no acid-fast bacilli were found on frequent examinations. The tests for occult blood were all plus.

May 14: A transfusion of 500 c.c. of whole blood was given. On this date, before transfusion, small purpuric spots were noticed on the thighs, legs, and back.

May 15: The tourniquet test was negative. The blood platelet count was 167,000; leukocyte count 20,300 (82 per cent segmented); bleeding time 4 minutes; clotting time 3 minutes.

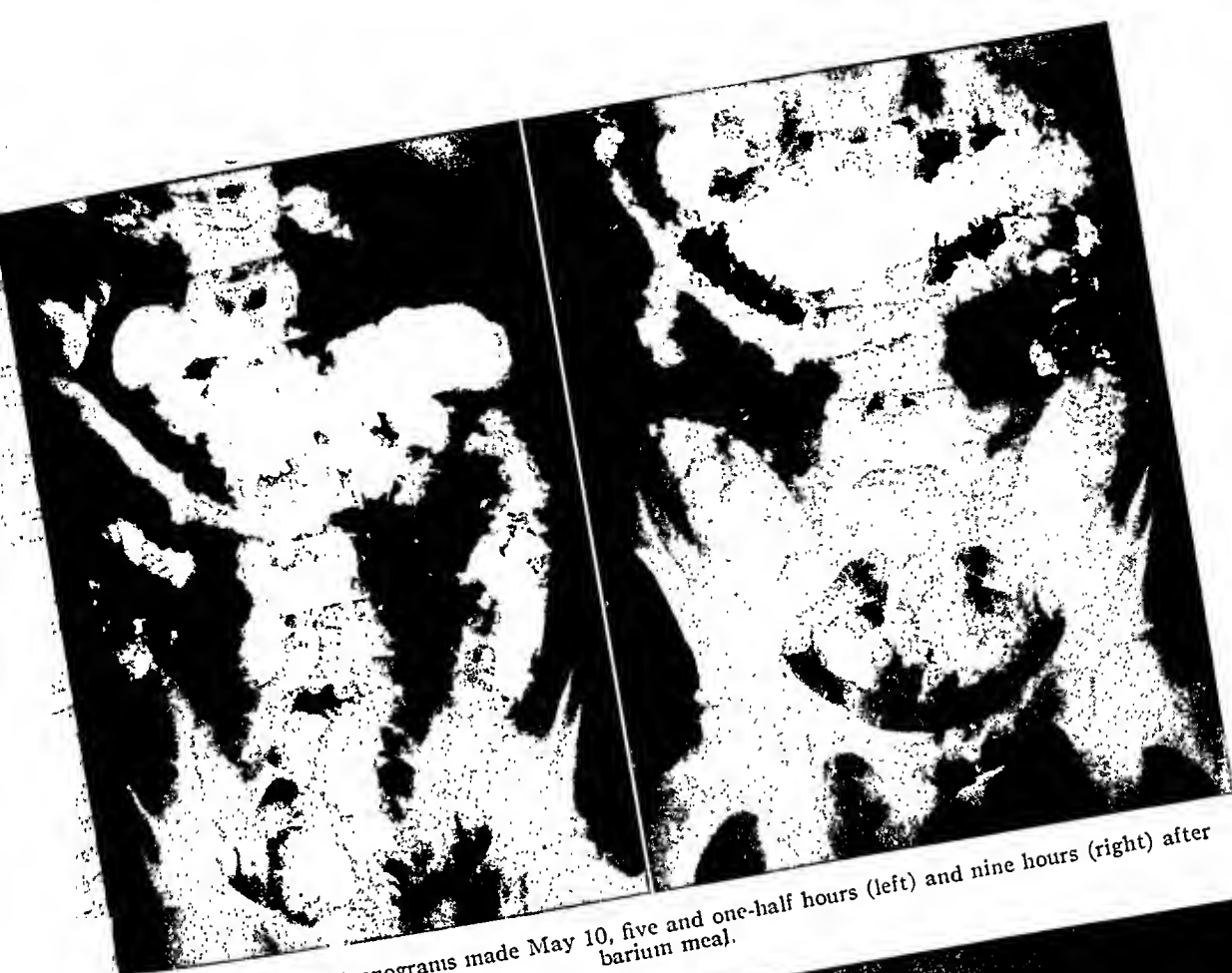
May 16: Slight swelling of the ankles.

May 17: The tourniquet test was repeated and was negative. Purpuric spots were more prominent. Platelet count 369,750.

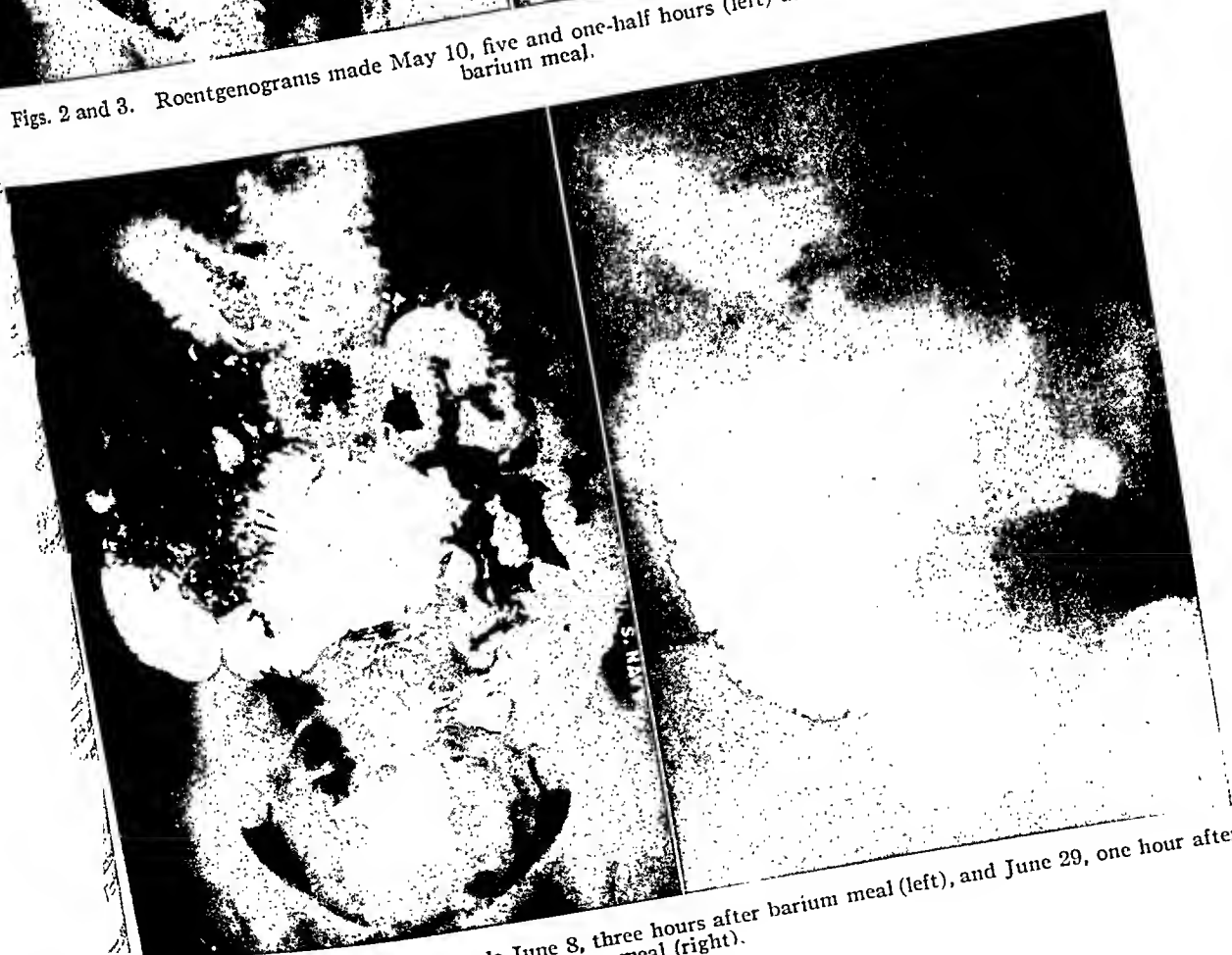
May 22: Patient has improved; feels well; purpuric spots fading; swelling of ankles has subsided. Stools are solid and formed. Vomiting has ceased. Weight 138 pounds.

May 27: Blood platelet count 200,000.

June 2: Patient feels well, with no complaints. Stools are normal. Food sensitivity tests are started, 53 food extracts being used.



Figs. 2 and 3. Roentgenograms made May 10, five and one-half hours (left) and nine hours (right) after barium meal.



Figs. 4 and 5. Roentgenograms made June 8, three hours after barium meal (left), and June 29, one hour after meal (right).

June 4: All food sensitivity tests negative except 1 plus reaction for peas and chocolate.

June 8: Gastro-intestinal examination shows marked improvement in small intestine (Fig. 4).

June 29: Re-examination shows practically normal small intestinal pattern (Fig. 5), with normal gastro-intestinal motility.

July 3: Patient has regained lost weight and feels well. He has been surveyed for discharge from the service.

SUMMARY

A young white male had symptoms of acute abdominal disease, with leukocytosis, moderate elevation of temperature, and blood in the vomitus and stools. He gave a history of previous similar attacks, but with no gross hemorrhage. X-ray examination on the tenth hospital day showed marked small intestinal changes. Purpura was not considered until purpuric skin lesions were observed on the fourteenth day in the hospital. Blood platelet counts were not made before the appearance of skin lesions; only one such count was definitely below normal. There was no definite eosinophilia.

It is suggested that x-ray studies of the small intestine may be of diagnostic aid in obscure abdominal cases.

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Dysgerminoma of the Ovary with Widespread Metastases¹

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IN 1931, Meyer first applied the term "dysgerminoma" to the ovarian counterpart of the testicular seminoma. Although there are approximately 200 cases reported in the literature up to 1939 (1), the dysgerminoma is a relatively uncommon ovarian neoplasm, its frequency being variously reported as 3 to 10 per cent of primary malignant tumors of the ovary (1, 5, 6, 7). It appears typically at an early age, becoming manifest most often in the second to fourth decades, and is characterized by a progressively enlarging pelvic mass which may reach large proportions. When this finding is associated with pseudohermaphroditism or other genital maldevelopment, the diagnosis should be strongly suspected. Novak (5), however, has pointed out that more than one-half of his patients had normal genital development. Various degrees of ascites may be present in about 10 per cent of patients (7).

The tumor is believed to be hormonally indifferent (3, 5), in conformity with Meyer's concept of its origin from "an undifferentiated form of germinal cells which have lost their faculty of becoming either masculine or feminine in type" (4). On the other hand, careful hormone studies have not been carried out in a sufficient number of patients to determine subclinical amounts of hormone production. This has been emphasized by Seegar (7).

The tumor is grossly rubbery or brain-like in consistency, and microscopically is made up of uniform cells separated into groups by fibrous septa which usually contain lymphoid cells. In some specimens there are scattered microscopic granulomatous nodules resembling tubercles. The degree of malignancy cannot be judged



Fig. 1. Appearance of patient on admission to the hospital.

from the microscopic appearance and is determined best at operation by the presence or absence of invasion or metastasis.

According to Novak (5), treatment should consist of removal of the involved ovary and adnexa. The opposite ovary should be removed only if involved. Opinion in the literature differs on the incidence of bilateral occurrence: Seegar (7) states that 20 per cent are bilateral, while Dockerty and MacCarty (1) give a higher figure, 35 per cent. The tumor is radiosensitive, and radiotherapy should play an important role in the management of recurrence and metastases (2, 5, 8).

The tendency of the testicular seminoma to widespread and early metastasis is well known. The dysgerminoma of ovarian origin, on the other hand, tends to grow to large dimensions and to invade locally the pelvic structures. Distant metastases are rare and, when they occur, often are confined to the abdominal viscera. Seegar (7) states that in his review of 79 cases reported in the literature and in 19 of his own patients there were only 3 with metastases and these were all within the abdo-

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Accessory Urethral Channel: Case Report

A Ne

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BECAUSE OF THE uncommon occurrence of an accessory urethral channel, the following case is reported in the radiological literature for the benefit of roentgenologists who may not read the urological periodicals. A more complete report of the same case by Capt. John S. Kessell, M.C., A.U.S., is awaiting publication in an as yet unannounced urological journal. The exact frequency of accessory urethral channels which run the length of the penis but fail to enter the bladder is not known, but Hinman cites McKenzie's report of 31 cases of accessory urethral channels. The length of the accessory channels is not mentioned.

CASE HISTORY

A white male soldier of 27, single, with thirty months of service in the Army, reported to the genito-urinary clinic on Sept. 11, 1943, complaining of a urethral discharge which had begun the morning before. There was no burning on urination. Exposure to infection occurred on Aug. 26, 1943. Sanitube prophylaxis was administered to the usual urethral orifice. Examination revealed a purulent urethral discharge. The urine showed cloudy shreds. A smear revealed Gram-negative intracellular diplococci. Sulfathiazole treatment (1.0 gm. every four hours, total dose, 24 gm.) was given, with the patient remaining on duty status.

When the discharge failed to clear completely, the patient was admitted to the hospital, Sept. 23, 1943, where the accessory sinus in the penis was discovered. The other parts of the examination were essentially the same as in the clinic. The blood count and serology were normal. Another course of sulfathiazole (4.0 gm. in the first dose, and 1.0 gm. every four hours) was given, being discontinued on Oct. 2, 1943. Urethral irrigations were also given, but the discharge continued.

The patient was then transferred to Letterman General Hospital, Oct. 8, 1943. There he received an 8.0-gm. course of sulfadiazine and three mechanical fever treatments (two for eight hours and one for seven hours, between 105 and 106° F., on Oct. 19, 23, and 30, respectively). Three silver nitrate irrigations were also done in the intervals between fever treatments and a No. 24 sound was passed on



Fig. 1. Urethrogram in oblique projection, showing the normal urethra filled with opaque material and an opaque catheter lying in the accessory urethral channel which ends at the symphysis pubis.

Nov. 24, 1943. The two-glass urine test, smears, and cultures were negative for *N. gonorrhoeae* soon after the treatments, and the patient was discharged from the hospital to duty status on Dec. 11, 1943.

A urethrogram was then made with opaque material introduced into the normal urethra and an opaque catheter introduced into the sinus above the normal urethra. The accessory channel was found to run the whole length of the penis and to end blindly at the symphysis pubis (Fig. 1). Its diameter was approximately half that of the normal urethra. Its presence was no doubt at least partly responsible for the failure of the prophylactic treatment, since the latter was administered only to the normal opening. The accessory channel probably became infected and, due to its proximity, maintained the infection in the normal channel by direct inoculation of organisms.

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¹ Accepted for publication in April 1945.

A New Method of Making Radon Ointment¹

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IN USING THE Kohn-Richards method of making radon ointment at the Philadelphia General Hospital, certain changes in the method seemed desirable. The Kohn-Richards method consists of agitating lanolin in the presence of radon. This re-

In view of these features, an investigation was undertaken to find an adsorbent substance which could be used to occlude radon to a greater degree and maintain the radiation intensity under atmospheric conditions or, failing in this, to determine

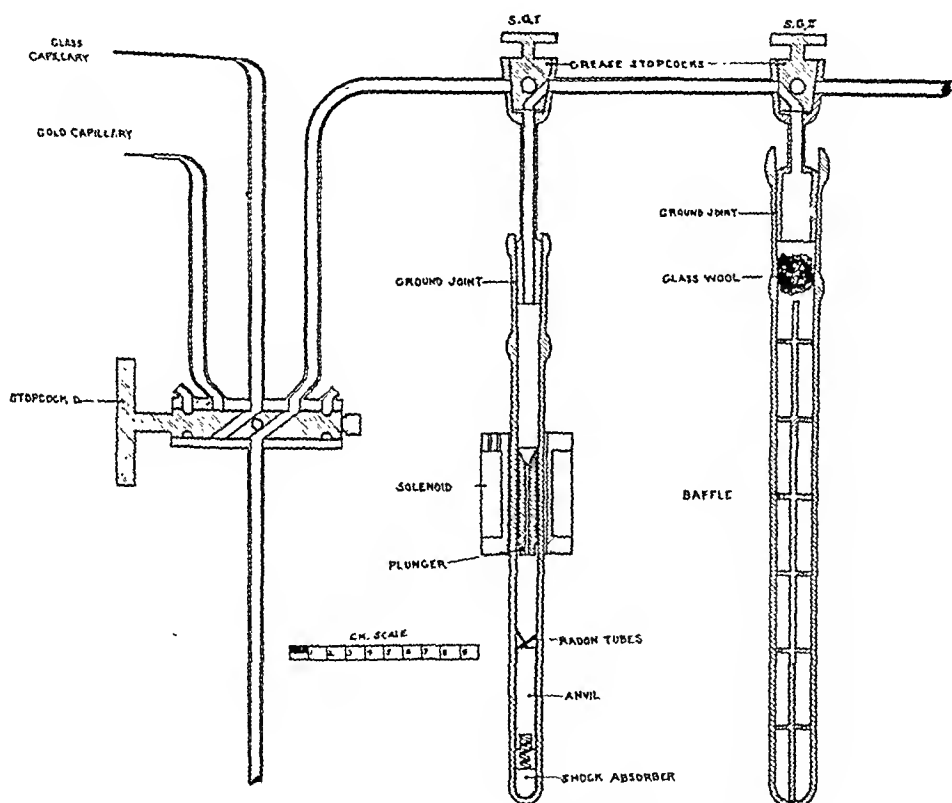


Fig. 1. Apparatus for impregnating charcoal with radon.

ults in a mechanical enclosure of the radon in the form of minute bubbles when the lanolin solidifies. Tests show that when this ointment is exposed to air its radiation intensity falls more rapidly than would be expected from the exponential decay of radon itself. Furthermore, it would seem, from the nature of the method and from tests made, that there is a definite upper limit to the concentration of radon per cubic centimeter of lanolin.

what modification could render available substances occlusive.

The utilization of charcoal for the production and improvement of a vacuum has long been known to physicists. It was therefore considered suitable for this purpose. It was found that when granular charcoal was properly degassed by heating in a vacuum it could thereafter adsorb radon to a high degree. The adsorption of the radon could be made to approach 100 per cent if the degassing was carefully

¹ Accepted for publication in April 1945.

controlled. It was found, however, that the charcoal lost about 80 per cent of the radon in twenty-four hours when exposed to air. That is, the radiation emission of the substance did not follow the law of radon decay but dropped with considerably greater rapidity. This drawback was almost entirely overcome by distributing the substance in liquid petrolatum or any other similar emollient while cooling. The

attached stands within the chamber. Each of these disks has a hole drilled in it in such a way that the holes in adjacent disks are 180 degrees displaced from one another. This arrangement constitutes a baffle and aids in preventing the adsorbent from circulating into the remainder of the apparatus while being degassed.

In making the ointment, air is admitted into stopcock *D*, the crusher, and the

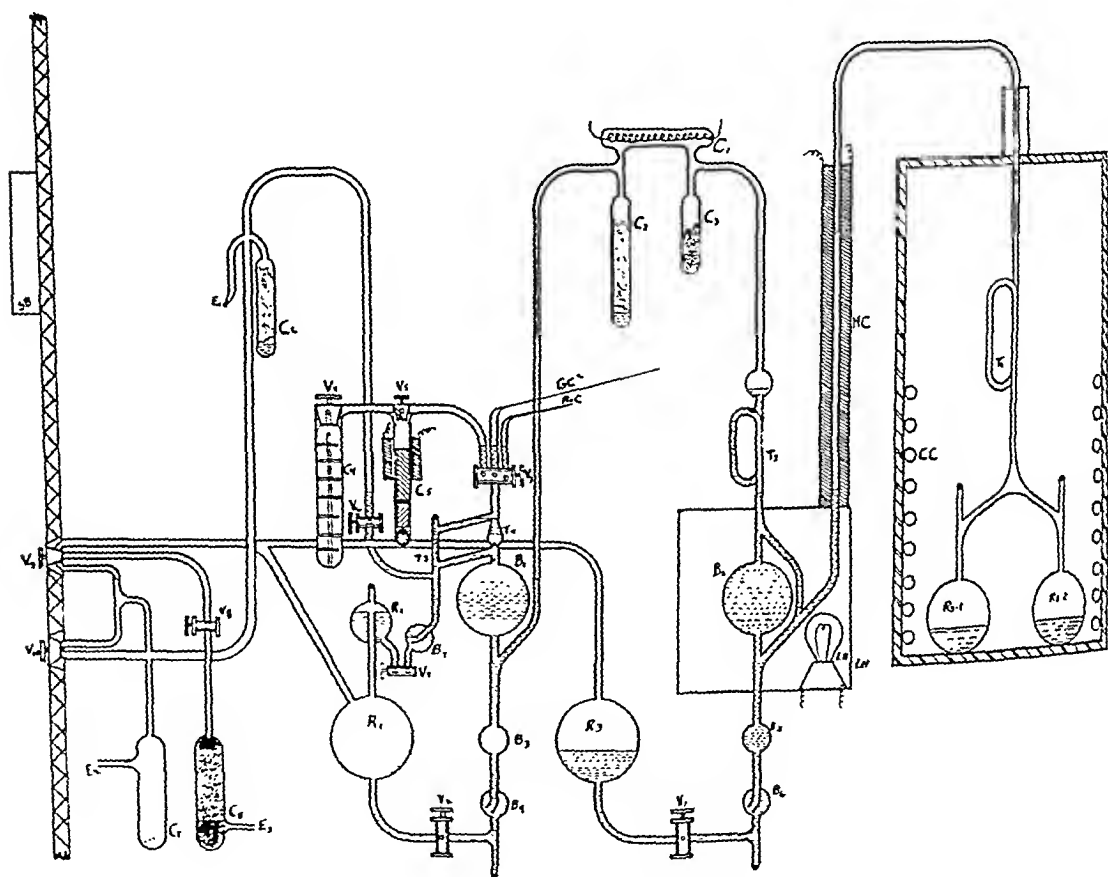


Fig. 2. Failla-Duane radon apparatus to which is attached the apparatus shown in Figure 1.

radiation decay was then approximately that of radon in a sealed container.

A description of the process is as follows: The radon tube crusher developed by the authors is used in conjunction with another pyrex chamber of somewhat similar construction. This chamber and the manner in which it is related to the rest of the apparatus are shown in Figures 1 and 2.

The degassing chamber has a ground tapered joint at its upper end. A brass rod to which a number of brass disks are

degassing chamber. The degassing chamber is then removed and some powdered or granular charcoal is placed in the bottom of the chamber. The baffle is inserted and clean glass wool packed over the uppermost baffle. The chamber is then rotated so as to distribute the grease on the ground joint, and clamped in a fixed position. Concentric with the degassing chamber is a pyrex cylinder of larger diameter which is wound with a number of turns of nichrome wire for heating the charcoal. The

sealed radon tubes are then inserted into the crusher. The evacuation of the system is begun. In order to take advantage of the adsorptive properties of the charcoal, it is first necessary to rid it of those gasses which are already adsorbed. On applying heat slowly to prevent excessive agitation of the charcoal and at the same time slowly evacuating the degassing chamber, the initial turbulence due to the outgassing

length of time should be allowed for it to expand into the degassing chamber. When this is done, the charcoal is poured into liquid petrolatum and thoroughly stirred. When the ointment cools, it is ready for use.

It was found possible, when using granular charcoal, attapulugus clay, decalco, and alumina, to dispense with the baffle system and simply use a plug of

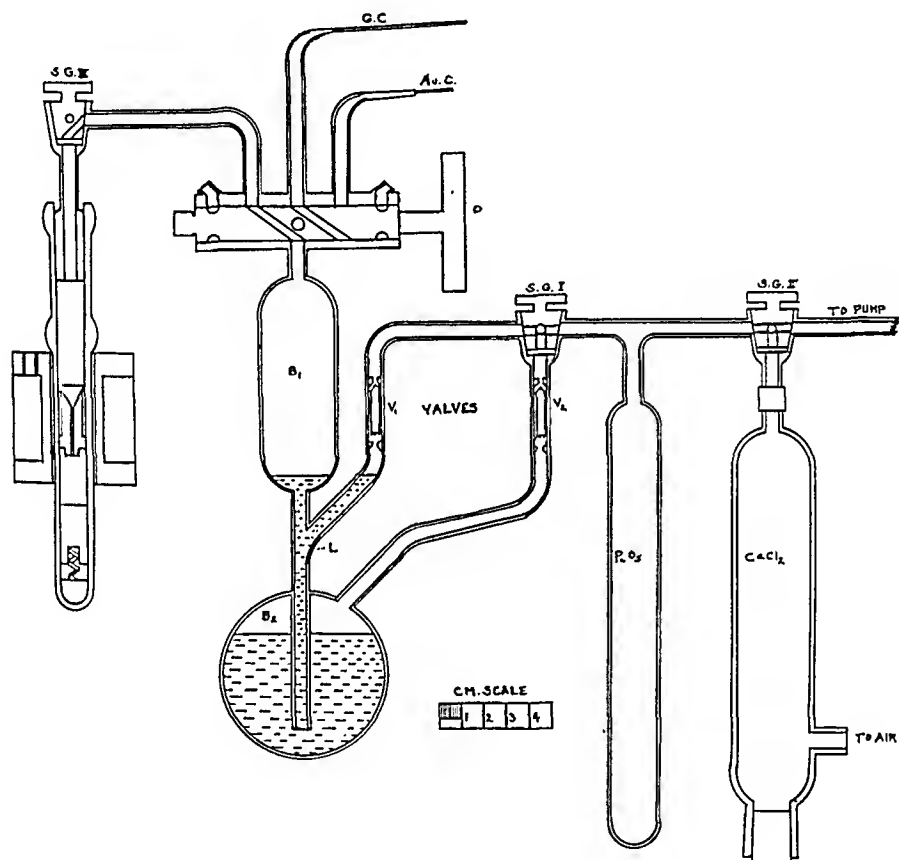


Fig. 3. Apparatus for impregnating charcoal with radon, attached to its own vacuum system.

will subside. The evacuation and heating are continued for half an hour, at the end of which time the charcoal may be considered to be sufficiently degassed. The apparatus is then isolated from the emanation plant to which it is attached, after which the radon tubes are crushed and the radon permitted to diffuse into the charcoal and be adsorbed as the charcoal slowly reaches room temperature. Since radon is a heavy gas and hence diffuses slowly, a reasonable

glass wool to prevent diffusion into the remainder of the system during the degassing process. To expedite the degassing of the adsorbents previous to their activation by radon, the nichrome heater was done away with and a torch used to apply heat to the chamber for a five- to fifteen-minute interval while simultaneously evacuating the system. Evidently complete outgassing is not secured in such a short time, but it is generally sufficient

for the purpose. The same procedure as described for the activation of charcoal with radon is followed for other adsorbents.

To facilitate this investigation and other similar ones, the authors devised a compact apparatus requiring an addition of only a mechanical vacuum pump. Thus it was possible to separate entirely the experimental procedure from the radon emanation plant. Figure 3 shows this apparatus.

In conclusion, it may be said that it has been found possible to make radon ointment more conveniently and to achieve a

higher millicurie intensity by activating granular charcoal, attapulgus clay, decalco, or alumina with radon and mixing it with an emollient than is possible by the emulsion method.

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Philadelphia, Penna.

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Protection Measurements of Lead-Shielded Radium¹

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MOST DATA ON radium protection are based on the absorption coefficients obtained with narrow collimated beams and on the application of the "inverse-square" law. Yet, in the majority of protection problems we are dealing with radiation that is not limited to a small cross section and with conditions where the scattered radiation from neighboring objects contributes considerably to the dose received by the radium workers. In this

ing of aquadag on the inside of the wall of the chamber served as the other electrode.

The center electrode of the chamber was charged to 525 volts as measured with a Wulf type electrometer. The chamber was then disconnected and exposed to the radiation for a period of not less than nine minutes. It was then removed from the beam and reconnected to the electrometer, where the voltage drop was observed. The exposures were timed to give a nearly con-

TABLE I: IONIZATION CHAMBER CHARACTERISTICS

Chamber No.	Shape	Wall Material	Wall Thickness (mm.)	Inside Diameter (cm.)	Inside Length (cm.)	Calculated Volume (c.c.)
SX-10	Spherical	Lucite	3.0	9.5	..	449
SX-11	Spherical	Polystyrene	3.0	10.4	..	588
CX-F4	Cylindrical	Presdwood	3.5	13.6	13.4	1946

study we have compared the transmission of gamma radiation through lead for narrow and broad beams. Experiments were arranged also to determine the validity of the "inverse-square" law as applied to radium protection. Finally, a study was made of the protection obtained with lead shields of the type used while handling radium.

APPARATUS AND EXPERIMENTAL PROCEDURE

The characteristics of the three types of ionization chambers used in this investigation are shown in Table I. The spherical chamber, SX-11, was used for all the measurements² after preliminary tests had shown that the difference in transmission obtained with the two spherical chambers was within the experimental error. All the chambers had an aluminum rod of 3 mm. diameter as center electrode, while a coat-

stant voltage drop (about 225 volts), thereby eliminating possible errors due to lack of linearity of the electrometer scale. Correction was made for the natural leakage, which was of the order of 0.05 to 0.1 division per hour.

The source of radiation was a 305.8-mg. capsule of radium or a radon bulb with an initial value of 400-500 millicuries. Each source had a filtration equivalent to 0.5 mm. Pt.

NARROW BEAM MEASUREMENTS

In Figure 1 is shown the arrangement used in making the lead absorption measurements with a collimated beam. The shield was made up of lead bricks, 2 X 3 X 4 inches, and 8-inch lead squares 1 inch thick, all placed around a center lead casting provided with a conical hole 30 cm. long and with a diameter varying from

¹ From the Physics Laboratory, Department of Hospitals, City of New York. Read by title at the Joint Meeting of The American Roentgen Ray Society and the Radiological Society of North America, Chicago, Ill., Sept. 24-29, 1944.

² Except for the transmission through 19 cm. of lead, where the dosage rate was extremely low and the large cylindrical chamber was used.

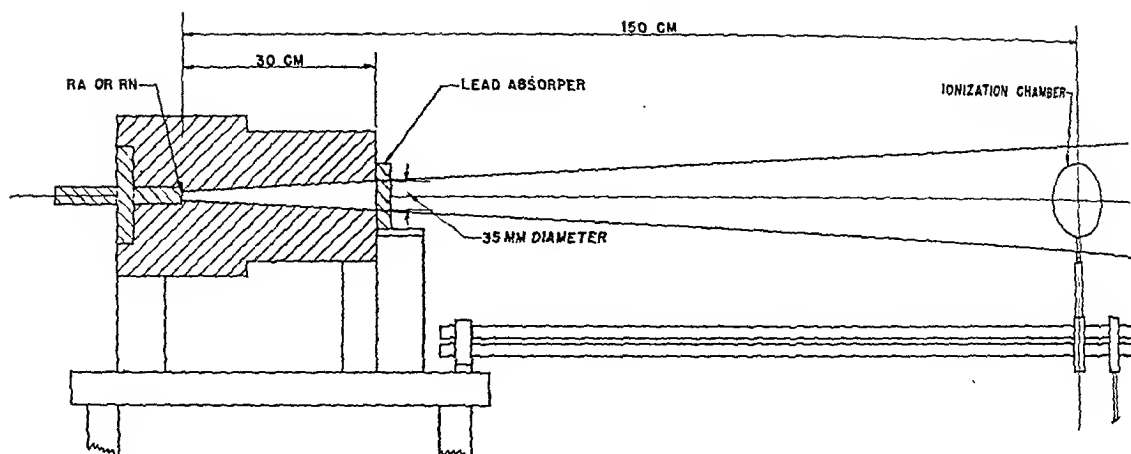


Fig. 1. Schematic drawing showing arrangement used for making narrow beam absorption measurements.

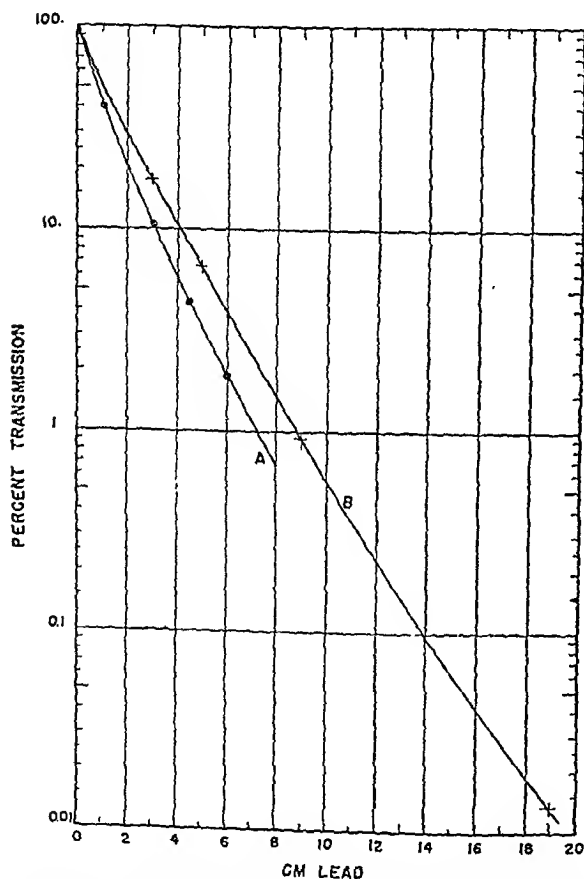


Fig. 2. Transmission of gamma radiation through lead in per cent of value with 0.5 mm. platinum. Curve A. Narrow beam. Curve B. Wide beam.

10 to 35 mm. The radium or radon was located at the end of a removable lead plug provided with a 1-inch lead shield and handle.

The chamber was mounted on an optical bench permitting a range in radium-ionization chamber distance of 150 to 250

cm. The beam was so directed that there was no back-scatter from any object within a distance of 10 meters from the chamber. Lead absorbers of two different sizes were used, sheets or blocks, 7 cm. and 10 cm. square. They were placed in the beam in contact with the shield at the aperture. The thickness of the lead was determined by micrometer readings and by weighing. Both checked within 1 per cent for a density of 11.36. It was found that, for the same thickness, there was no difference in transmission of the 7- and 10-cm.-square lead absorbers. This indicates that the transmission of radiation through the front of the shield was insignificant.

Preliminary measurements were made at different distances to check the "inverse-square" law. The maximum variation from the "inverse-square" law was found to be 1.5 per cent over a range of 150 to 250 cm. in radium-ionization chamber distance. The ratio of the measured to the calculated values increased with the distance. This may be explained by the contribution of scattered radiation.

Curve A, of Figure 2, indicates the percentage transmission obtained with the narrow beam at a radium distance of 150 cm. The 100 per cent refers to the reading obtained without any lead absorber in the beam. This reading was taken between successive absorption measurements, thereby eliminating the need for air density corrections. A comparison of our ab-

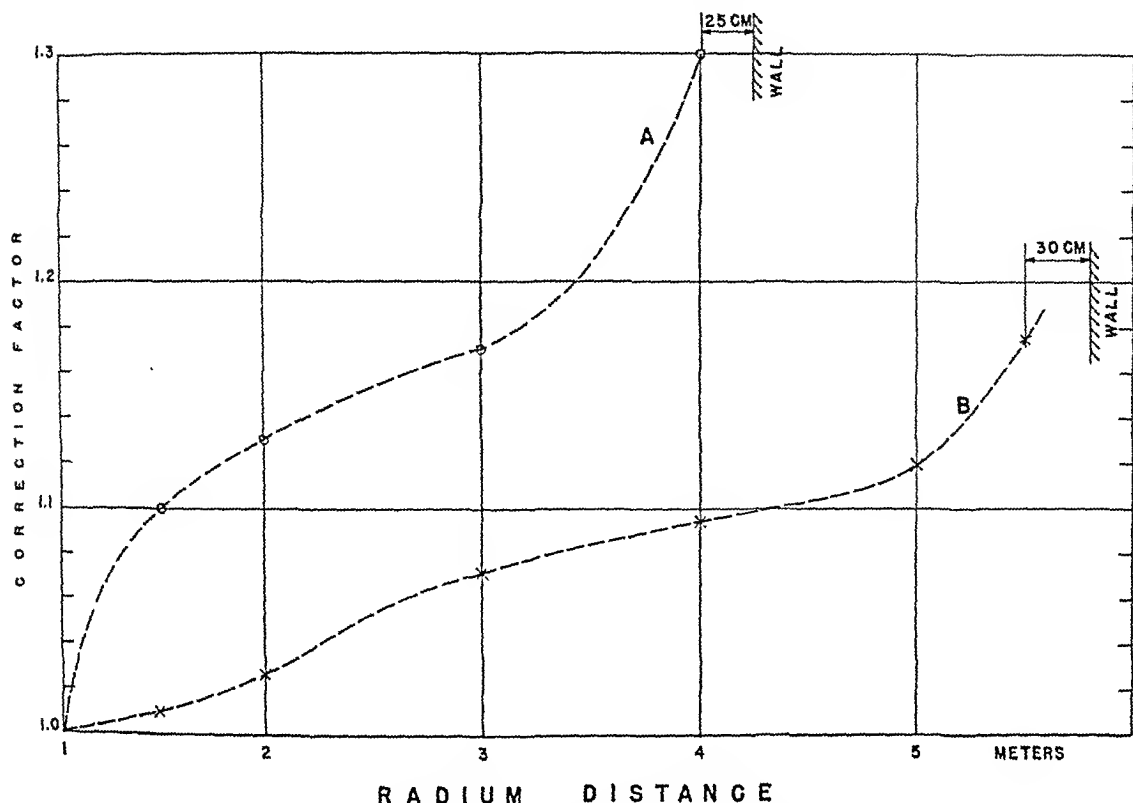


Fig. 3. Distance correction factor for wide beams. The factor indicates the ratio of the measured and calculated dosage rate.

sorption curve with those by Kaye and Binks (1) shows that ours is lower than their experimental and slightly higher than their calculated absorption curves.

WIDE BEAM MEASUREMENTS

Wide beams of radiation were obtained by completely surrounding the radium with lead of increasing thickness. Special cylinders were constructed to fit snugly inside each other and to provide a range in wall thickness from 1 to 19 cm. The smallest cylinder had a bore of 1 cm. to hold the radium capsule or radon bulb. The top and bottom of each cylinder had the same thickness as its wall. The cylindrical shape was chosen to duplicate the type of container commonly used for storing and transporting radium. The measurements were made with the radium located 50 cm. from the wall and at the center of a table with a wooden top 88 cm. above the floor. The ionization chamber was mounted on a tripod with the center of the chamber kept at the level of the radium.³

Curve B, of Figure 2, indicates the percentage transmission obtained with the non-collimated beam and with a radium-chamber distance of 150 cm. The 100 per cent refers to the reading obtained with the unshielded radium capsule (filtration equivalent to 0.5 mm. Pt) resting on the table top. This value was found to be 18 per cent higher than that measured with the radium freely suspended in the air.

COMPARISON OF NARROW AND WIDE BEAMS

A comparison of curves A and B indicates that the percentage transmission of the narrow beam falls off much more rapidly than that of the non-collimated beam. For instance, at 6 cm. of lead it is 1.88 per cent against 3.85 per cent, or a ratio of almost 1 to 2. For still greater thicknesses of lead, the ratio becomes even higher. The difference in slope of the two curves

³ Except for the lower filtrations, where it was slightly higher so that the bottom of the chamber always was above the table. This was done to prevent absorption by the table top, which would reduce the radiation reaching the ionization chamber.

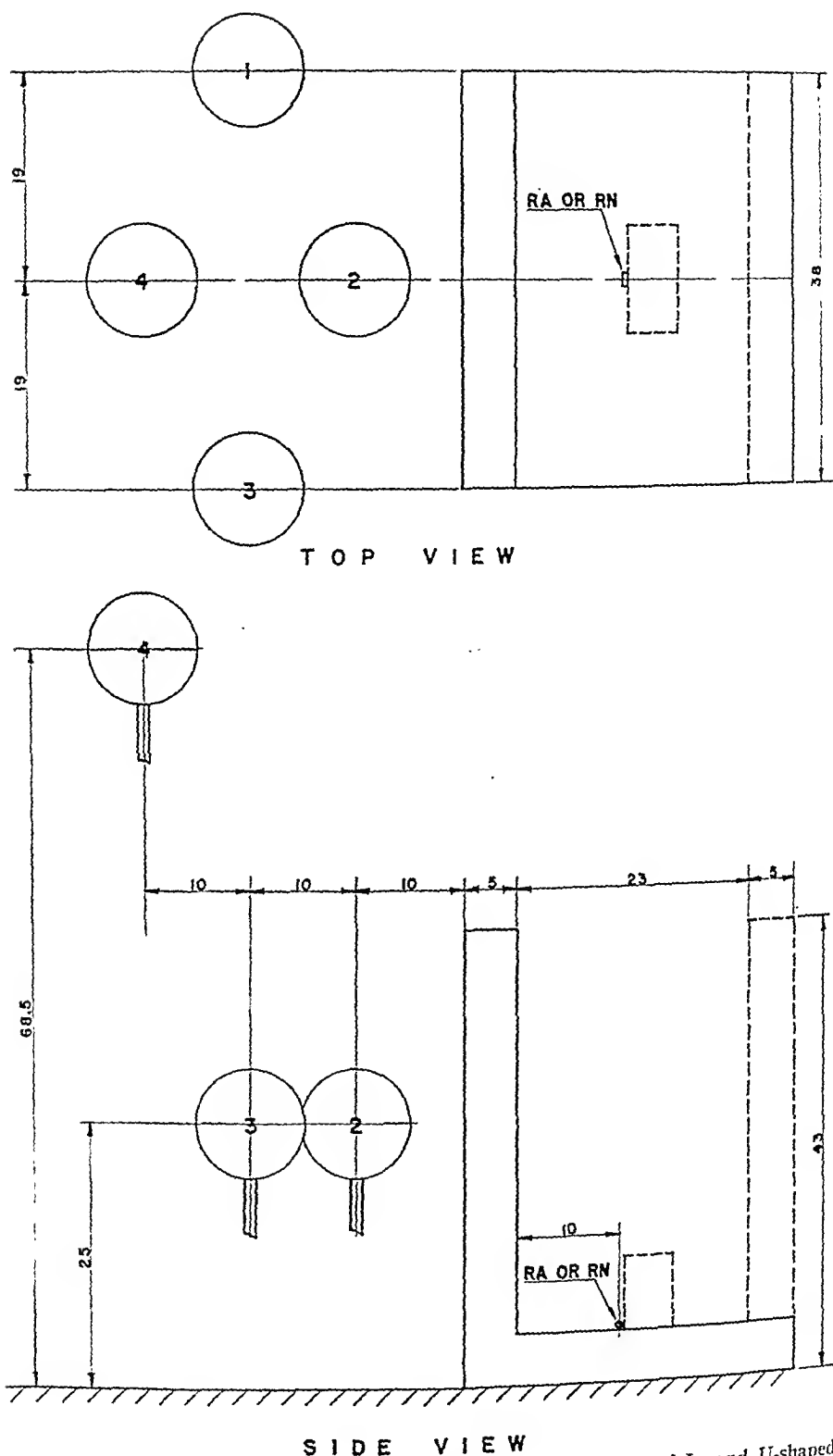


Fig. 4. Experimental set-up used for protection measurements of L- and U-shaped lead shields.

may be explained by the scattered radiation reaching the ionization chamber from the lead containers used with the non-collimated beam. It is, therefore, impor-

tant to select the absorption curve which is obtained with an experimental arrangement which simulates closely condition met in practice. The set-up used for B wa

arranged with that in mind, and the results, therefore, are applicable to most protection problems.

DISTANCE CORRECTION FOR WIDE BEAMS

Measurements were made, also, at other distances to determine how closely the dosage rate follows the inverse-square law under conditions found in practice. The results of these measurements are shown in Figure 3, where the correction factors indicate the ratio of the measured values to those calculated by applying the "inverse-square" law to the dosage rate at 100 cm. Curve A shows the results of measurements in a smaller room, 12 X 18 ft., with a ceiling height of 11 ft. The radium was located in a corner, 50 cm. from each wall, and the dosage rate was measured along a line passing through the corner and the radium. Curve B indicates the results for a large, irregular shaped room, about 23 X 27 ft., with a ceiling height of 21 ft. Here the radium was placed 50 cm. from the center of one wall and readings were made along the center line of the room. Both sets of measurements show that the correction factor increased with distance and it rose rapidly as a wall was approached. The slightly irregular values may be explained by scattering from the objects in the room. As might be expected, the correction factors were higher for the smaller room, where the ionization chamber was closer to the walls and ceiling. The experiment indicates clearly that scattered radiation may add materially to the calculated dosage rate as obtained by considering the primary radiation only. The measurements show, also, that the correction factor varies widely according to experimental conditions and it is not possible to establish standard correction curves, nor to incorporate this correction into protection charts which could be universally applicable.

LEAD PROTECTION SHIELDS

The preparation of radium or radon applicators is usually carried out behind L-shaped lead blocks, thereby reducing

TABLE II: PROTECTION MEASUREMENTS OF LEAD SHIELDS

	mr per 100 mc.-hr. at positions*			
	1	2	3	4
Experimental arrangement				
L shield against wall.....	15.6	31.7	15.8	5.8
L shield against wall with lead brick back of radium.....	13.1	30.8	13.2	2.2
L shield in middle of room.	13.8	31.0	14.0	1.3
U shield against wall.....	15.5	29.7	15.6	3.7

* See Figure 4 for the location of positions.

materially the primary radiation reaching the body of the operator. Such barriers, however, offer only very limited protection against the scattered rays from nearby walls and other objects. Various methods of reducing the scattered radiation were studied by means of the experimental arrangement shown in Figure 4. Four ionization chambers were placed at the position of the operator and measurements were made with a radon capsule resting on the lead block. The radon had an initial value of 111 mc. and was filtered with 1 mm. of platinum. The results of the measurements are shown in Table II for the four arrangements used:

(a) The L-shaped lead shield was placed with the back against a wall of concrete blocks.

(b) The arrangement was the same as (a), except that a 2 X 3 X 4-inch lead brick had been placed directly back of the radon applicator.

(c) The lead shield was placed in the middle of the room without the lead brick in place.

(d) The lead shield was moved back against the wall and a 2-inch (5 cm.) thick lead panel was added to the back, making the shield U-shaped.

The results show that the dose received by the operator may be cut down materially by reducing the scattered radiation. The lead brick back of the radium offers a simple and effective means of limiting the scattered radiation. In order to provide maximum protection, however, the lead brick should be close to the radium or radon and in some instances this may interfere with preparation of the applicators.

A somewhat similar improvement in protection is obtained by having the lead block located at a distance from walls and other scattering objects. This suggests placing the lead block in front of a window, where the scatter will be a minimum. The U-shaped lead block does not offer much improvement, as most of the wall is still exposed to primary radiation. Measurements were made, also, with L protection shields provided with lead glass windows, such as are used in radiologic departments. The results showed that the protection could be improved to a similar extent by the above modifications.

SUMMARY AND DISCUSSION

The results of this study show that the lead absorption coefficients obtained with narrow beams of gamma rays cannot be applied directly for determining the thickness of protective barriers. Such data should be obtained from absorption measurements made with wide beams and with an experimental set-up which represents practical conditions as closely as possible.

The results of such measurements are presented in Figure 2.

In the past, scattered radiation has received too little consideration in radium-protection problems. Often a sense of security was felt if the radium was back of a lead block of sufficient thickness to reduce the primary radiation to the permissible dose, irrespective of the protection provided against scattered radiation. Much improved protection may be had if the scattered radiation is reduced by limiting the cross section of the beam or by locating the radium at a distance from scattering objects.

NOTE: The writer wishes to express his appreciation to Dr. G. Failla for his suggestions and co-operation. He also wishes to thank the Radium Chemical Co. for the loan of the radium and Gordon H. Cameron of this Laboratory for his assistance with the experimental work.

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Pelvicephalometry¹

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THE PURPOSE OF this paper is to present two simple tables for facilitating pelvic and fetal head mensuration. Table I is to be used in conjunction with the stereoscopic method of pelvicephalometry (1-5); Table II is to be used in conjunction with the triangulation method.

Subsequent to calculation of these tables, it was found that Hodges (9) had presented the formula used in obtaining Table I and a graph based on this formula to be used in correction of distortion in the stereoscopic method. Table II represents data identical with those obtainable from nomograms (10, 11), pelvic slide rules, and calculations from a formula or correction factor graph (9). Though neither table represents more than a presentation in tabular form of data the principles of which have been discussed by several writers, it is thought that such tabulation may prove time-saving.

STEREOSCOPIC METHOD: TABLE I

Table I is obtained from the formula $X = F \left(\frac{T}{S + T} \right)$, where X is the true length of any diameter parallel to the film, F the image length of the diameter as measured on the film, T the total tube shift, and S the image shift on the superimposed stereoroentgenograms. By using a 3-inch tube shift, substituting various values of image shift and film image measurement in the formula, and correcting for image shift of the lead markers used in the method, the data for Table I were obtained.

Table I, then, is a correction table for diameters of the pelvis or fetal head which are parallel to the film. In the anteroposterior film, all transverse diameters of the pelvis will be in a plane parallel to the film. With the fetal head in an approximately transverse position with reference to the maternal pelvis, the occipito-frontal

and suboccipito-bregmatic diameters will be parallel to the film; with the head in a sagittal position with reference to the pelvis, the biparietal diameter will be parallel to the film.

General Roentgen Technic

1. Anteroposterior stereoroentgenograms are obtained with the patient in the supine or erect (10) position, with an exact 3-inch tube shift, 36-inch target-film distance, and Potter-Bucky diaphragm.

2. Two lead markers are placed on top of the table beneath the patient's buttocks, one on either side, in such a manner that the image of both markers will appear on both films.

Measuring Image Shift and Film Diameters

1. On one of the films draw the transverse diameters of the pelvis which it is desired to measure (the maximum transverse diameters of the pelvic inlet and outlet, intraspinous diameter, and any other arbitrary diameters sufficiently well visualized), extending these lines well past the ends of the diameters. Indistinct landmarks such as the mesial edges of the ischial spines should be marked on both films by perforating the films with a pointed instrument so that they may be seen when the films are superimposed.

2. Place the films together with the marked film on top, accurately superimposing the images of the lead markers.

3. With a pointed instrument, perforate both films at the points where the lateral edge of the pelvic inlet on both films crosses the line representing the maximum transverse diameter of the inlet. Similarly, perforate both films at the points where the most mesial edge of the ischial spines on both films crosses the line representing the intraspinous diameter. The same is done with any other transverse diameter marked

¹ From the Radiological Branch, Letterman General Hospital, San Francisco, Calif. Accepted for publication in March 1945.

Image Shift (millimeters)

	5	7	9	11	13	15	17	19	21	23	25	27	29	31
80	72	70	68	67	65	64	63	61	60	59	58	57	56	55
82	73	72	70	69	67	66	64	63	62	60	59	58	57	56
84	75	73	72	70	69	67	66	64	63	62	61	60	59	58
86	77	75	73	72	70	69	67	66	65	63	62	61	60	59
88	79	77	75	74	72	70	69	68	66	65	64	63	61	60
90	80	79	77	75	74	72	70	69	68	66	65	64	63	62
92	82	80	78	77	75	74	72	71	69	68	67	65	64	63
94	84	82	80	79	77	75	74	72	71	69	68	67	66	65
96	86	84	82	80	79	77	75	74	72	71	70	68	67	66
98	88	86	84	82	80	78	77	75	73	72	71	70	68	67
100	89	87	85	83	82	80	78	77	75	74	72	71	70	69
102	91	89	87	85	83	82	80	78	77	75	74	72	71	70
104	93	91	89	87	85	83	82	80	78	77	75	74	72	71
106	95	93	90	89	87	85	83	82	80	78	77	75	74	73
108	97	94	92	90	88	86	85	83	81	80	78	77	75	74
110	98	96	94	92	90	88	86	85	83	81	80	78	77	76
112	100	98	96	94	92	90	88	86	85	83	81	80	78	77
114	102	100	97	95	93	91	89	88	86	84	83	81	79	78
116	104	101	99	97	95	93	91	89	88	86	84	82	81	80
118	106	103	101	99	97	94	93	91	89	87	85	84	82	81
120	107	105	102	100	98	96	94	92	91	89	87	85	84	82
122	109	107	104	102	100	98	96	94	92	90	88	87	85	84
124	111	108	106	104	102	99	97	95	94	92	90	88	86	85
126	113	110	108	105	103	101	99	97	95	93	91	90	88	87
128	115	112	109	107	105	103	100	98	97	94	93	91	89	88
130	116	114	111	109	106	104	102	100	98	96	94	92	91	89
132	118	115	113	110	108	106	103	101	100	97	96	94	92	91
134	120	117	114	112	110	107	105	103	101	99	97	95	93	92
136	122	119	116	114	111	109	107	104	102	100	98	97	95	93
138	124	121	118	115	113	110	108	106	104	102	100	98	96	95
140	125	122	119	117	115	112	110	107	105	103	101	100	98	96
142	127	124	121	119	116	114	111	109	107	105	103	101	99	98
144	129	126	123	120	118	115	113	111	108	106	104	103	100	99
146	131	128	125	122	120	117	114	112	110	108	106	104	102	100
148	132	129	126	124	121	118	116	114	111	109	107	105	103	102
150	134	131	128	125	123	120	118	115	113	111	109	107	105	103
152	136	133	130	127	124	122	119	117	114	112	110	108	106	105
154	138	135	131	129	126	123	121	118	116	114	112	110	107	106
156	140	136	133	130	128	125	122	120	117	115	113	111	109	107
158	141	138	135	132	129	126	124	121	119	117	115	112	110	109
160	143	140	137	134	131	128	125	123	121	118	116	114	112	110

TABLE I: DISTORTION CORRECTION TABLE FOR THREE-INCH TUBE SHIFT

The value in millimeters of the image shift of the desired transverse diameter as determined from the stereorontgenograms is found in the horizontal column at the top of the table. The value in millimeters of the film measurement of the desired transverse diameter is found in the vertical column at the left of the table. Where these two meet, read the corrected value of the desired diameter.

on the top film. Likewise, perforate both films at the most lateral point on both images of the fetal skull. In all of these it is necessary to make the perforations at one end of the diameter only, as the image shift is equal at both ends.

4. Separating the films and inspecting the one having the marked diameters, it will be seen that the distance between the perforations at one end of a diameter represents the image shift for that diameter. The length of each diameter and the image shift for that diameter are measured in millimeters and recorded on the film along the line representing that particular diameter. The image shift for the fetal skull

is measured and recorded on the film as are the occipito-frontal and suboccipito-bregmatic diameters (or, if the skull be in a sagittal position with reference to the pelvis, the biparietal diameter is recorded instead).

5. Having recorded the length of each diameter and the image shift for each, merely find these in Table I and read the corrected value in millimeters.

6. In the event that the measured diameter is larger than those included in the table, find the corrected value for one-half the measured diameter and multiply this figure by two to obtain the true value of the diameter.

"BT" and "OT" (centimeters)

	BT	26	28	30	32	34	36	38	40	42	44	46
	OT	13	14	15	16	17	18	19	20	21	22	23
Film Measurement (millimeters)	80	64	63	63	62	61	60	59	58	57	56	55
	82	66	65	64	63	62	61	61	60	59	58	57
	84	68	67	66	65	64	63	62	61	60	59	58
	86	69	68	67	66	65	64	63	63	62	61	60
	88	71	70	69	68	67	66	65	64	63	62	61
	90	72	71	70	69	68	67	66	65	64	63	62
	92	74	73	72	71	70	69	68	67	66	65	64
	94	76	75	74	73	71	70	69	68	67	66	65
	96	77	76	75	74	73	72	71	70	69	68	67
	98	79	78	77	76	74	73	72	71	70	69	68
	100	80	79	78	77	76	75	74	73	72	71	69
	102	82	81	80	79	78	76	75	74	73	72	71
	104	84	82	81	80	79	78	77	76	74	73	72
	106	85	84	83	82	81	79	78	77	76	75	74
	108	87	86	85	83	82	81	80	79	77	76	75
	110	88	87	86	85	84	82	81	80	79	78	76
	112	90	89	88	86	85	84	83	81	80	79	78
	114	92	90	89	88	87	85	84	83	82	81	79
	116	93	92	91	90	88	87	86	84	83	82	81
	118	95	94	92	91	90	88	87	86	85	84	82
	120	96	95	94	93	91	90	88	87	86	85	83
	122	98	97	95	94	93	91	90	89	87	86	85
	124	100	98	97	96	94	93	91	90	89	88	86
	126	101	100	99	97	96	94	93	92	90	89	88
	128	103	101	100	99	97	96	95	93	92	90	89
	130	105	103	102	100	99	97	96	95	93	92	90
	132	106	105	103	102	100	99	98	96	94	93	92
	134	108	106	105	104	102	100	99	97	96	95	93
	136	109	108	106	105	103	102	101	99	97	96	94
	138	111	110	108	107	105	103	102	100	99	97	96
	140	113	111	110	108	106	105	103	102	100	99	97
	142	114	113	111	110	108	106	105	104	102	100	99
	144	116	114	113	111	110	108	106	105	103	102	100
	146	117	116	114	113	111	109	108	106	105	103	101
	148	119	118	116	114	113	111	109	108	106	105	103
	150	121	119	118	116	114	112	111	109	107	106	104
	152	122	121	119	117	116	114	112	111	109	107	106
	154	124	122	120	119	117	115	114	112	110	109	107
	156	125	124	122	121	119	117	115	113	112	110	108
	158	127	125	124	122	120	118	117	115	113	112	110
	160	129	127	125	124	122	120	118	116	114	113	111

TABLE II: DISTORTION CORRECTION TABLE FOR SAGITTAL PLANE OF PELVIS, TUBE-FILM DISTANCE 36 INCHES
 The external bitrochanteric diameter, "BT," or the midsacral-table top measurement, "OT," in centimeters is found in the horizontal columns at the top of the table. The desired sagittal plane diameter in millimeters is found in the vertical column at the left of the table. Where these meet, read the corrected value in millimeters.

TRIANGULATION METHOD: TABLE II

Table II is used to correct diameters in the sagittal plane of the pelvis as measured on the lateral film. These corrected diameters with the transverse diameters obtained as described above give all the necessary true pelvic measurements. If the fetal head is lying in the pelvic inlet, an additional measurement may be obtained to supplement those obtained from the anteroposterior film.

Table II is obtained from the formula $X = F \left(\frac{H - O}{H} \right)$, where X is the true measurement of any diameter in the

sagittal plane of the pelvis, F the length of this diameter as measured on the film, H the target-film distance, and O the distance of the sagittal plane from the film. By using a target-film distance of 36 inches, substituting various values of film measurements and sagittal plane-film distances, and correcting for a tabletop-film distance of 5 cm., the data for Table II were obtained.

General Roentgen Technique

A single lateral film of the pelvis is made at a 36-inch target-film distance. If the film is made in the erect position, the ex-

ternal bitrochanteric diameter ("BT" in Table II) is measured and recorded by the technician. If the film is made with the patient in the horizontal position, the distance from the center of the sacrum to the top of the table ("OT" in Table II) may be measured instead of the external bitrochanteric diameter, as an appreciable error may otherwise be introduced due to compression of the underlying soft tissue.

Correction of Film Measurements

To correct any diameter in the sagittal plane of the pelvis (anteroposterior diameter of the inlet, subpubic tip of sacrum measurement, etc.), it is necessary only to measure the diameter in millimeters on the film and, using either the value of the external bitrochanteric diameter ("BT") or the midsacral-tabletop measurement ("OT") in Table II, read the corrected value from the table.

SUMMARY AND CONCLUSIONS

1. Two simple tables to be used in pelvicephalometry have been presented. Table I is to be used in correction of transverse pelvic diameters and fetal head diameters as seen on anteroposterior stereo-roentgenograms. Table II is to be used in correction of sagittal plane diameters as seen on the lateral film.

2. The method is simple, requires no

special apparatus either for making the films or in correction of distortion and also permits stereoscopic viewing of the birth canal.

NOTE: The author wishes to express his appreciation to Major A. E. Imler, M.C., Radiological Branch, Letterman General Hospital, for his valuable suggestions and for editing the manuscript.

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Studies in Vitro on Cellular Physiology

The Effect of X-Rays on the Survival of Cells¹

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THE IMPORTANCE of x-rays in the therapy of cancer and other diseases has stimulated a considerable number of investigations on the effect of this agent on cells *in vitro*, in order to obtain a biologic test of dosage and to determine the mechanism of the action of the rays. Much of this work has been done with cells from plants and invertebrate animals, such as yeast and eggs of *Drosophila*. Most investigators realized, however, that it would be desirable to use cells from mammalian sources and preferably from man. Accordingly, every new *in vitro* method for the study of living cells was soon utilized to determine the effect of x-rays.

The development of methods for transplantation of tumors in animals led to the investigations by Contamin in 1909 (1), Wedd and Russ in 1912 (2), Wood and Prime in 1915 (3), and more recently by Crabtree and Cramer in 1934 (4). These men subjected pieces of a transplantable tumor to x-rays or radium and tested the effectiveness of the radiation by inoculation of the irradiated tissue into animals. An analogous method was used by Rahm and Koese (5), who grafted irradiated and non-irradiated pieces of skin.

The technic of tissue culture has been repeatedly used to study the effect of x-rays. The early workers in this field were Wood and Prime in 1914 (6), and Kimura in 1919 (7). A review of the literature was published by Spear in 1935 (8). More recently Stenstrom, King, and Henschel (9) studied the effect of x-rays on cultures of lymph nodes, and Osgood (10) on cultures of human bone marrow.

Warburg's manometric method for studying respiration and metabolism of

cells was utilized to determine the effect of x-rays by Frik and Posener in 1926 (11), Holmes (12), Crabtree (13), and Goldfeder and Fershing (14).

A technic which may be called a deferred histologic method was used by Warren and Whipple (15) and by Colwell (16) to study the effect of radiation on autolysis of tissues.

In this laboratory, the method of unstained cell counts has been found useful in studying the reactions of cells to physical and chemical reagents, such as heat (17), oxygen (18), glucose (18), antiseptics (19), and anisotonic solutions (20). The method was used in this study to determine whether irradiation with x-rays affects the survival of cells in suspensions derived from the thymus, spleen, bone marrow, and testis of rabbits and from normal and leukemic blood of man.

THYMUS

Under aseptic conditions, the thymus of a rabbit was removed and chopped up with scissors after the addition of a small amount of phosphate-Ringer solution (5 per cent of a fifteenth-molar phosphate buffer pH 7.6 in Ringer's solution). The suspension was filtered through an 80-mesh Monel metal wire screen in a Seitz filter and then centrifuged for five minutes at approximately 1,200 revolutions per minute. The precipitated cells were resuspended in phosphate-Ringer solution to make a concentration of approximately 200 viable cells per millimicroliter. Bacteriologic cultures in broth were made to check the sterility. The suspension was distributed in 0.2 c.c. amounts in small pyrex test tubes (100 × 13 millimeters).

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The suspensions in the test tubes were irradiated at room temperature (78° F.) with the following factors: 250 kv., 10 ma., 50 cm. distance, 1 mm. aluminum filter, approximately 120 r per minute, half-layer value 0.7 mm. copper. The dosage from 20 to 5,000 r was measured by an integron which was adjacent to the test tubes during irradiation. The pyrex glass of the tubes absorbed 5 to 10 per cent of the radiation so that the suspension received only 90 to 95 per cent of the stated dosage. The irradiation was performed under the supervision of Major Harry Slobodin, M.C.

The microscopic objective was a 4-mm. lens, n.a. 0.85, and the eyepieces were wide field with a magnification of 15 times. The counts were expressed as the number of cells per millimicroliter in the incubated suspension. Previous work has shown that the unstained cells may be assumed to be viable and the stained cells dead.

Smears were made of the mixture of suspension and eosin and were stained by Gram's method to rule out the presence of bacteria. The mixture was also centrifuged, and smears on cover slips were made of the precipitated cells. The preparations

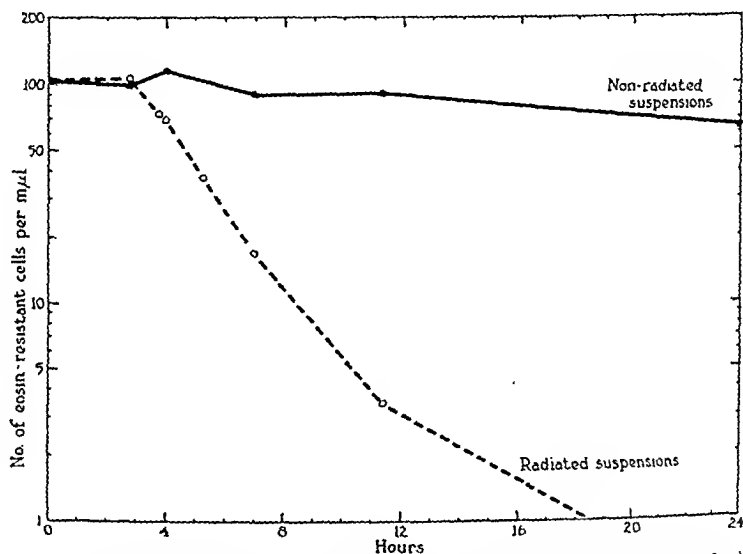


Fig. 1. The number of eosin-resistant cells in irradiated (1,000 r) and non-irradiated thymic cell suspensions incubated at 37° C. The abscissa represents the time of incubation in hours; the ordinate, the logarithm of the number of eosin-resistant cells per millimicroliter. Irradiation caused a rapid decrease in the number of unstained cells after a latent period of three hours.

After irradiation, the tubes were stoppered and incubated in a water bath at 37° C. During incubation, they were shaken horizontally at a rate of 140 times per minute. At varying intervals, counts were made of the suspensions. Eosin 1:1,000 in Tyrode's solution at pH 7.4 was added to the suspensions in the test tubes to make a final volume of 4.0 c.c. The mixture was shaken for two minutes, a drop was placed in a hemacytometer, and a count was made of the number of stained, unstained, and red blood cells. The hemacytometer was equipped with the thin polished cover slip of the Petroff-Hausser counting chamber.

were stained with hematoxylin and eosin and by Wright's or Giemsa stain for cytologic study.

A suspension derived from the thymus of a rabbit was irradiated with 1,000 r, was incubated at 37° C., and was examined every few hours. The number of unstained cell counts in an irradiated and in a non-irradiated control suspension is shown in Figure 1. The graph shows that irradiation of the suspension did not appreciably affect its viable cell count during the first three hours of incubation (count changed from 103 to 109 cells). After the third hour, the count of viable cells decreased

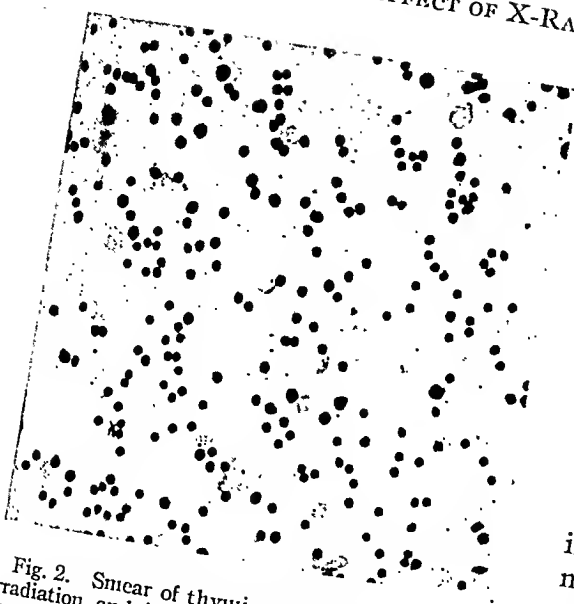
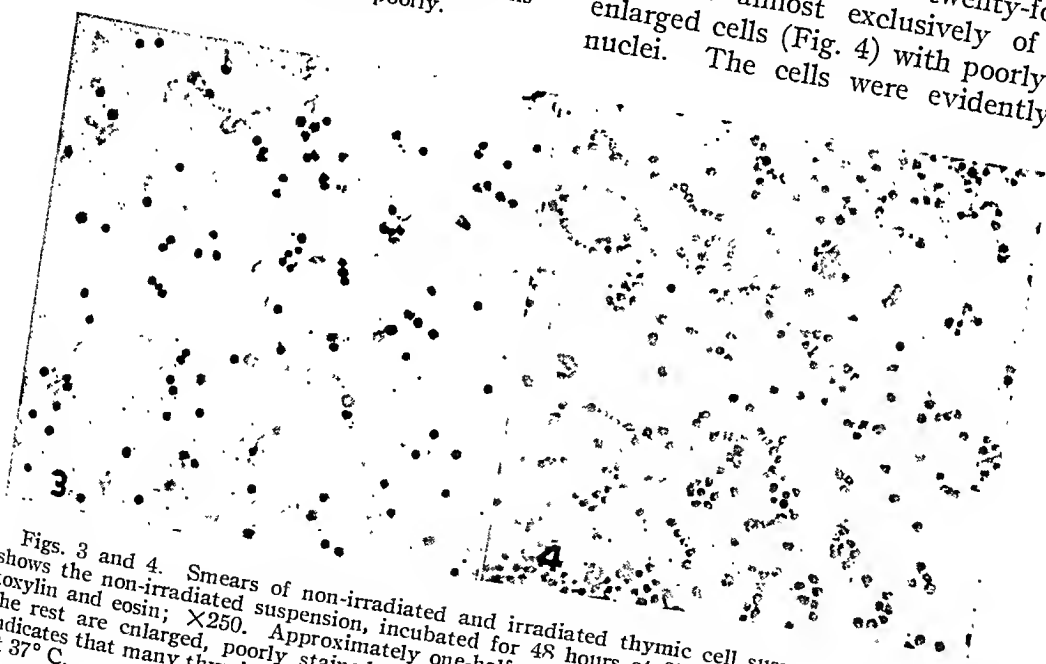


Fig. 2. Smear of thymic cell suspension before irradiation and incubation; stained with hematoxylin and eosin; $\times 250$. Nearly all of the cells are lymphocytes which are well stained and are morphologically normal. A small number of cells are enlarged or ruptured and stain poorly.



Figs. 3 and 4. Smears of non-irradiated and irradiated thymic cell suspensions. Fig. 3 shows the non-irradiated suspension, incubated for 48 hours at 37°C .; stained with hematoxylin and eosin; $\times 250$. Approximately one-half of the cells are well stained lymphocytes; the rest are enlarged, poorly stained, and evidently undergoing degeneration. The smear indicates that many thymic cells remained morphologically normal after 48 hours of incubation at 37°C .

Fig. 4 is a smear of thymic cell suspension which was exposed to 1,000 r and was incubated for 24 hours at 37°C .; stained with hematoxylin and eosin; $\times 250$. Nearly all of the cells are slightly enlarged and stained faintly or irregularly with hematoxylin. The smear shows that irradiated thymic cells underwent morphologic degenerative changes after incubation at 37°C .

hours of incubation (from 103 to 62.7 cells). Smears of the suspension before irradiation and incubation showed on microscopic examination (Fig. 2) numerous small, and a few large, well preserved and well stained lymphocytes which were apparently normal in morphologic appearance. A few cells in the smear were larger than normal, irregular in outline, with large nuclei which stained light purplish in color and had no definite structure. These cells were obviously in various stages of degeneration.

In smears of non-irradiated suspensions incubated for forty-eight hours, approximately half of the lymphocytes were well preserved and normal in appearance (Fig. 3). In contrast, smears of the irradiated suspension incubated for twenty-four hours consisted almost exclusively of slightly enlarged cells (Fig. 4) with poorly stained nuclei. The cells were evidently in an

early stage of degeneration. Normal lymphocytes were infrequent. In other experiments, suspensions that were irradiated and incubated for twenty-four and forty-eight hours gave smears consisting of rapidly and in twenty-four hours only 0.4 viable cells per millimicroliter were found. In contrast, the non-irradiated suspension showed only a moderate decrease in the unstained cell count after twenty-four

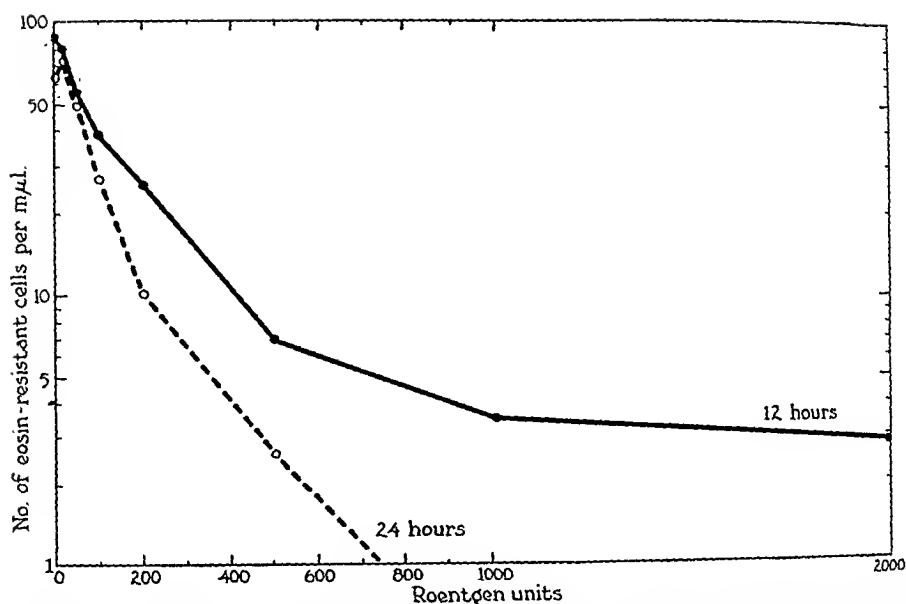


Fig. 5. Number of eosin-resistant cells in thymic cell suspensions exposed to varying dosages of radiation and incubated for 12 and 24 hours at 37° C. Irradiation with 50 r and incubation caused a slight but appreciable decrease in the number of eosin-resistant cells.

large ruptured cells and debris which took a light basophilic stain. Evidently the dead cells in the suspensions were fragile and were readily traumatized in preparing the smear. It may be concluded from the histologic observations that lymphocytes in thymic suspensions underwent degenerative changes following irradiation with 1,000 r and incubation for twenty-four hours.

The findings obtained by the method of unstained cell counts and by smears were in agreement. It seemed that irradiation with 1,000 r killed lymphocytes after a short latent period. The cytotoxic action was evidenced by the capacity of the irradiated and incubated lymphocytes to stain with eosin in suspension and by the degenerative morphologic cellular changes observed in smears.

To determine the effect of dosage, a suspension derived from the rabbit thymus was subjected to 20 to 2,000 r of radiation and was examined after twelve and twenty-four hours of incubation. The unstained cell counts are shown in Figure 5. It is seen from the graph that, between 50 and 1,000 r, the greater the dosage of radiation, the greater was the decrease in the number of viable cells. Increasing the amount of

radiation above 1,000 r failed to increase appreciably the radiation effect. Below 50 r, no definite effect on the viability of thymic cells was discernible.

SPLEEN

Suspensions derived from the spleen of the rabbit were prepared in the same manner as those from the thymus. In the original suspension, the differentiation of unstained, stained, and red blood cells in the hemacytometer was relatively easy, as the red cell could be recognized by its sharp outline, its yellowish color, its spherical shape, and the absence of any internal structure. In contrast, the unstained cell had a softer outline, a slightly bluish color, and a somewhat flattened, finely granular surface. In incubated suspensions, differentiation between the unstained cell and the enlarged distorted erythrocyte could be done with facility and confidence only by an individual with experience in counting cells.

A suspension derived from rabbit spleen was subjected to 1,000 r of radiation and was examined at irregular intervals. The unstained cell counts on the irradiated and on a control, non-irradiated suspension are shown in Figure 6. The graph shows that

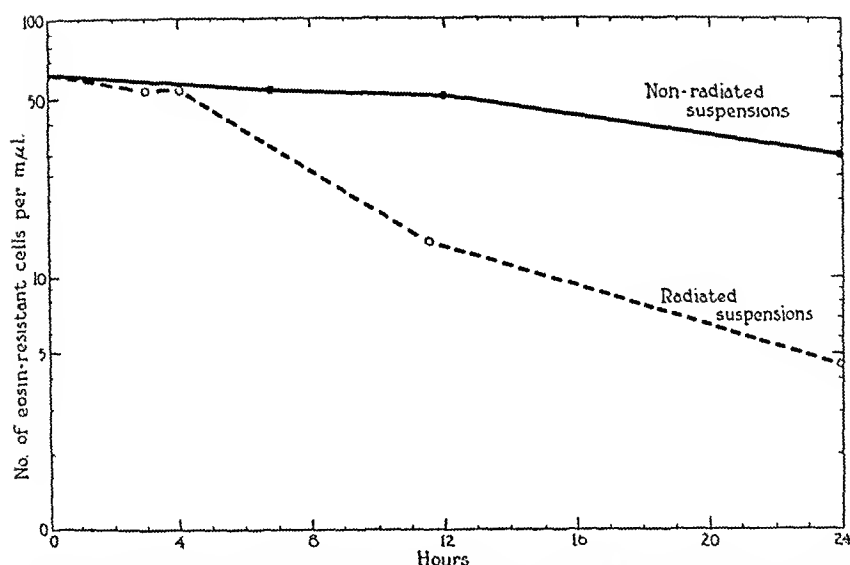


Fig. 6. Number of eosin-resistant cells in irradiated (1000 r) and non-irradiated, splenic cell suspensions incubated at 37° C. Irradiation caused a slow but definite decrease in the number of unstained cells after a latent period of four hours.

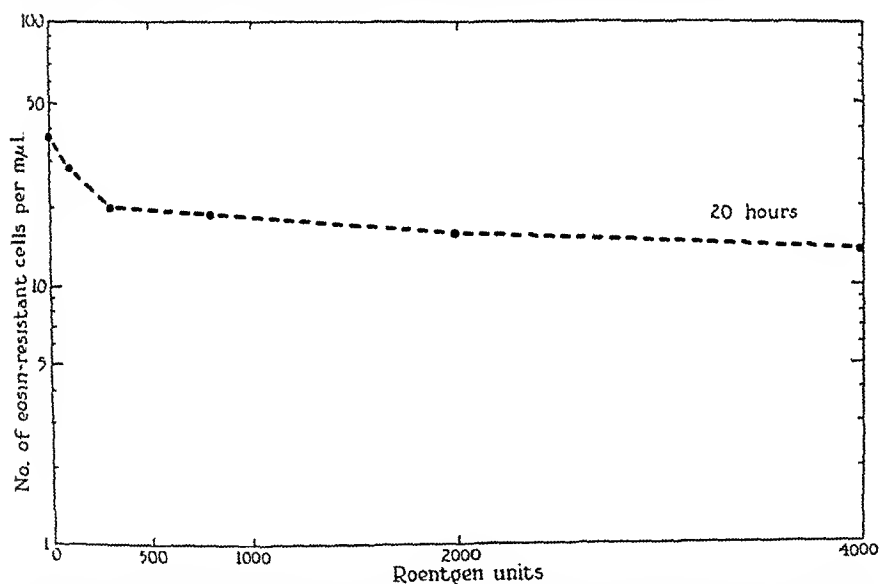


Fig. 7. Number of eosin-resistant cells in splenic cell suspensions exposed to varying dosages of radiation (100 to 4,000 r) and incubated for 20 hours at 37° C. Many cells remained eosin-resistant even after exposure to 4,000 r and incubation for 20 hours.

there was a latent period of at least four hours during which the radiation had no perceptible effect. After this latent period, the number of viable cells in the irradiated suspension decreased slowly. In the control suspension there was only a slight decline in the number of unstained cells. After twenty-four hours of incubation, 4.5 cells per millimicroliter still resisted staining in the irradiated suspension but 29 cells were resistant to eosin in the control.

A suspension derived from rabbit spleen

(containing 67 viable cells per millimicroliter) was irradiated with varying dosages. Counts and smears were made after twenty hours of incubation. The effect of radiation on the unstained cell count is shown in Figure 7. The non-irradiated suspension was found to have 36.5 viable cells after twenty hours of incubation at 37° C. The suspension which was treated with 100 r had a slightly lesser number of unstainable cells, 28. Increasing the dosage up to 4,000 r decreased progressively the number

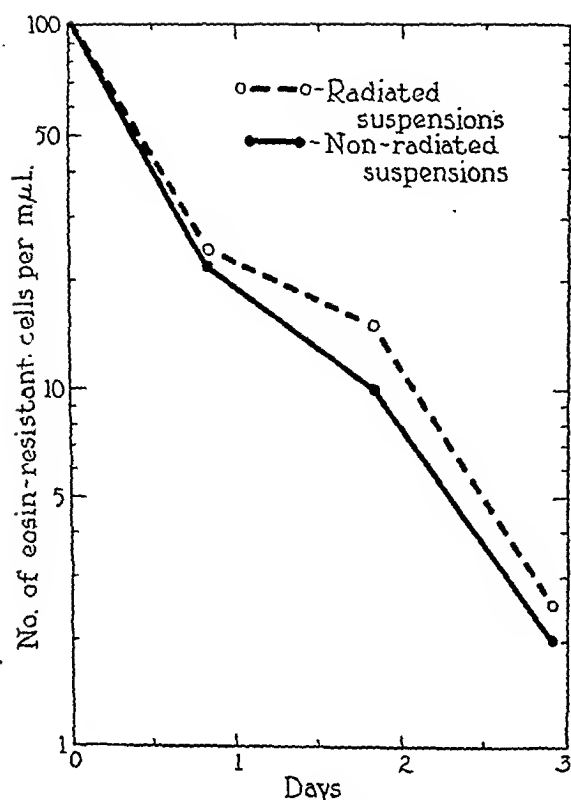


Fig. 8. Number of eosin-resistant cells in irradiated (1,000 r) and non-irradiated suspensions of bone marrow, incubated at 37° C. The radiation had no appreciable effect on the number of unstained cells in the suspension of bone marrow.

of unstained cells. It was evident that the greater the dose of radiation, the less was the number of unstained cells in the suspension.

There was one important difference in the effect of x-rays on suspensions derived from the spleen and the thymus. It was seen in Figure 1 that irradiation of the thymic suspension with 1,000 r caused an almost complete disappearance of the unstained cells in twenty-four hours (the count decreased from 103 to 0.4). In contrast, treatment of the splenic suspension with 4,000 r caused only a moderate decrease in the viable cells in twenty hours (from 67 to 13.5 cells). What is the cause of the difference? In counting the number of unstained cells in the splenic suspension irradiated with 4,000 r and incubated for twenty hours, it was observed that the unstained cells were large (12–15 micra in diameter), with many conspicuous, refractive granules. The persisting cells were evidently not lymphocytes. It appeared

that radiation had killed the lymphocytes but not the cells with granules.

To study in detail the radiosensitivity of various types of cells, smears were made of the suspensions. The stained smears of the original splenic suspension had numerous small and large, well stained lymphocytes and a few polymorphonuclear leukocytes. Most of the cells in suspensions incubated for twenty-four hours were, on the smears, in various stages of degeneration. The persisting well stained cells were moderate in number, and most of them were small lymphocytes. After irradiation and incubation, nearly all the cells in the smears were degenerated. The few well preserved cells were found to be neutrophilic and eosinophilic polymorphonuclear leukocytes. These observations indicated that irradiation and incubation caused degenerative changes in the lymphocytes but not in the granulocytes.

BONE MARROW

Bone marrow was obtained aseptically from the femurs of rabbits. The tissue was chopped up slightly with scissors and, by means of a piston, was pushed through an 80-gauge Monel metal wire screen in the barrel of a syringe. The suspension was then washed once with phosphate-Ringer solution and counts were made in the usual way. Counting of the cells in the hemacytometer was somewhat difficult, due to the necessity of differentiating between the unstained cells on the one hand and the hemoglobin-containing erythrocytes and normoblasts on the other.

A suspension of bone marrow was subjected to 1,000 r and was incubated in a water bath at 37° C. Counts and smears were made daily. The numbers of unstained cells in irradiated and non-irradiated suspensions are shown in Figure 8. It can be seen that the viable cells in the irradiated suspension decreased at approximately the same rate as those in the non-irradiated control. In other words, radiation had no apparent effect on the cells of the bone marrow according to the method of unstained cell counts.

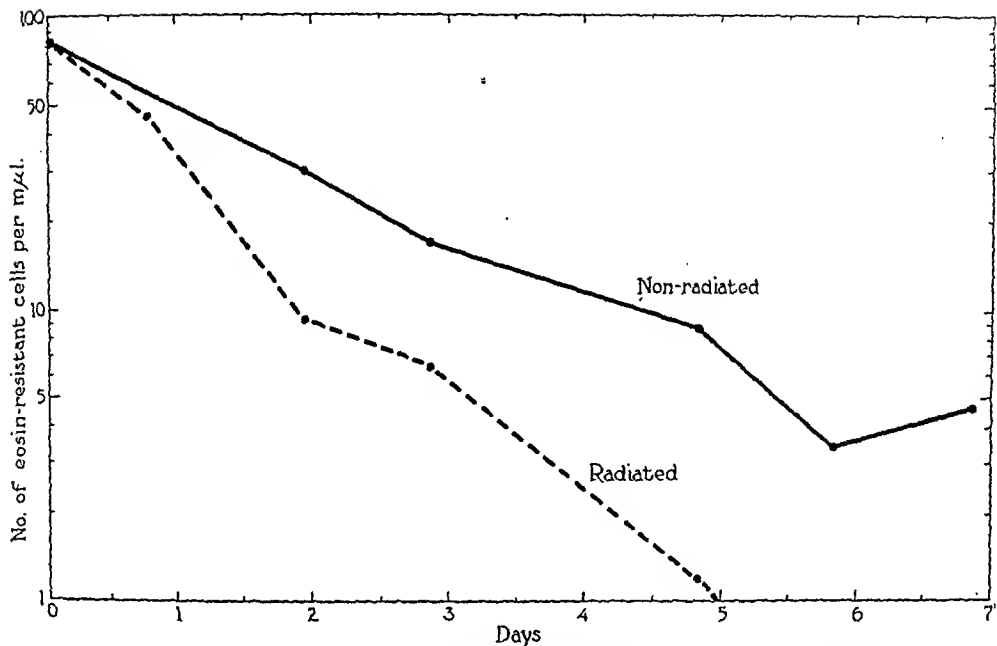


Fig. 9. Number of eosin-resistant cells in irradiated (1,000 r) and non-irradiated suspensions of normal human blood cells, incubated at 37° C. The irradiation caused a definite decrease in the number of unstained cells. In the non-irradiated suspension, many cells remained eosin-resistant even after seven days of incubation at 37° C.

Cytologic smears of the suspension of bone marrow were studied. No definite differences in the types of cells or in their morphologic appearance were observed in smears of the irradiated and control suspensions.

TESTIS

Suspensions prepared from the testes of immature or partly mature rabbits were irradiated and incubated as described previously. The results obtained by the method of unstained cell counts are shown in Table I. It is seen that the testicular suspension irradiated with 1,000 r had approximately the same unstained cell counts as the non-irradiated. The testicular cells in suspension were evidently resistant to the radiation.

Smears of the original testicular suspension had moderate sized and large cells with large nuclei and a considerable amount of cytoplasm. Only a small percentage of cells were in mitotic division. A few mature sperms were observed in the smears. After incubation for twenty-four hours, a moderate number of cells showed early and late signs of degeneration. The

TABLE I: EFFECT OF X-RAYS AND INCUBATION AT 37° C. ON SUSPENSIONS DERIVED FROM THE RABBIT TESTICLE

Hours of Incubation at 37° C.	No. of Eosin-Resistant Cells per Millimicroliter	
	Suspension Irradiated with 1,000 r	Suspension Not Irradiated
0	102	135
21.5	64	85
28.5	30	76
45.7		34

well preserved cells were similar in appearance to those seen in the suspension before incubation, but a few cells were very large and had 2 to 5 moderate-sized nuclei. No differences were observed in the smears obtained from irradiated and non-irradiated suspensions.

NORMAL HUMAN BLOOD

Blood (40 c.c.) from normal adult men was obtained and mixed with sodium citrate. After centrifugation of the blood, the buffy coat was transferred to hematocrit tubes and was again centrifuged at 4,000 revolutions per minute for thirty minutes. The white cells were then removed, washed once with isotonic saline

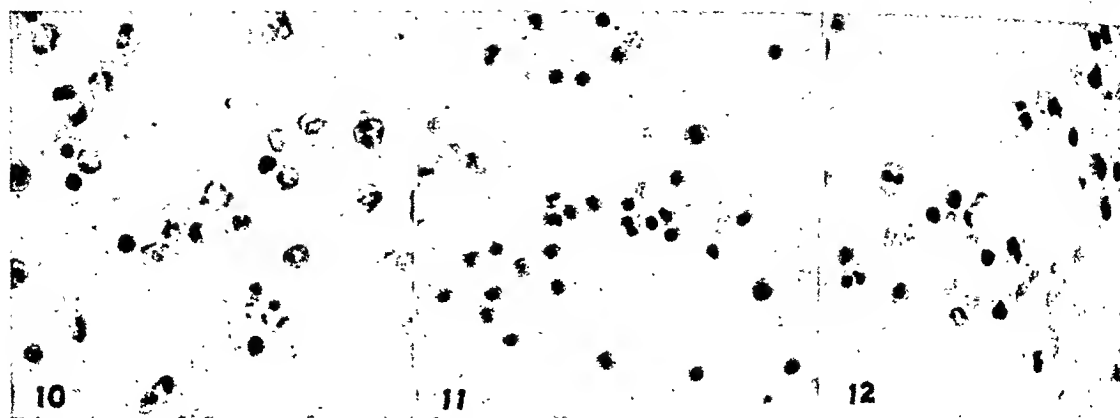


Fig. 10. Smear of suspension of normal human blood cells before irradiation and incubation; stained with hematoxylin and eosin; $\times 375$. The cells are neutrophilic and eosinophilic polymorphonuclear leukocytes and lymphocytes. An occasional cell is poorly stained.

Fig. 11. Smear of non-irradiated suspension of normal human blood cells incubated for three days at 37°C . stained with hematoxylin and eosin; $\times 375$. More than half of the cells are well stained and are seen to be lymphocytes and eosinophils. The rest of the cells are enlarged and poorly stained. The neutrophilic polymorphonuclear leukocytes did not survive satisfactorily incubation for three days at 37°C .

Fig. 12. Smear of irradiated (1,000 r) suspension of normal human blood cells incubated for three days at 37°C .; stained with hematoxylin and eosin; $\times 375$. Most of the cells are enlarged and stain poorly. The well stained cells are lymphocytes and eosinophils. Irradiation increased the number of degenerated cells.

solution and then with phosphate-Ringer's fluid. The washed cells were resuspended in phosphate-Ringer's solution and were irradiated and incubated as in the previously described experiments. In counting the viable cells in a hemacytometer, it was observed that some cells enlarged due to flattening of the cells on the glass slide. During this process, the cells became almost transparent and the cell outlines could not be made out. Care had to be taken not to overlook these cells in the unstained cell counts.

The decrease in the number of unstained cells in the irradiated (1000 r) and in non-irradiated suspensions is shown in Figure 9. It is seen from the graph that the number of unstained cells decreased much more rapidly in the irradiated than in the non-irradiated suspensions. After four days and twenty hours of incubation, the unstained cell count was 1.2 in the irradiated, and 8.6 cells in the non-irradiated suspension. From this and other experiments, it appeared that irradiation definitely decreased the period of survival of the white blood cells from normal persons.

Further data on the survival of irradiated and non-irradiated leukocytes were obtained by examination of smears. The original non-incubated and non-irradiated

suspension was found, on smear, to have many well preserved cells. Of these, 8 per cent were neutrophilic polymorphonuclear leukocytes, 11 per cent were lymphocytes and monocytes, and 7 per cent eosinophils (Fig. 10). A few cells showed degenerative changes and were not included in the differential count.

Smears of the non-irradiated suspension which had been incubated for three days were found to have (Fig. 11) many well stained, morphologically intact lymphocytes (65 per cent) and only a moderate number of neutrophils (21 per cent) and eosinophils (14 per cent). Many cells were degenerated. It appears from the smears that most of the neutrophilic leukocytes could not survive three days of incubation at 37°C ., but the lymphocytes and the eosinophilic leukocytes did survive.

The suspension that was irradiated and incubated for three days was also studied by smears (Fig. 12). A high percentage of the cells in the smear were degenerated. The cells that were well preserved were predominantly lymphocytes (58 per cent), and a moderate number of eosinophils (22 per cent) and neutrophils (20 per cent). Smears of irradiated suspensions incubated for four to six days had a few lymphocytes but many intact eosinophils.

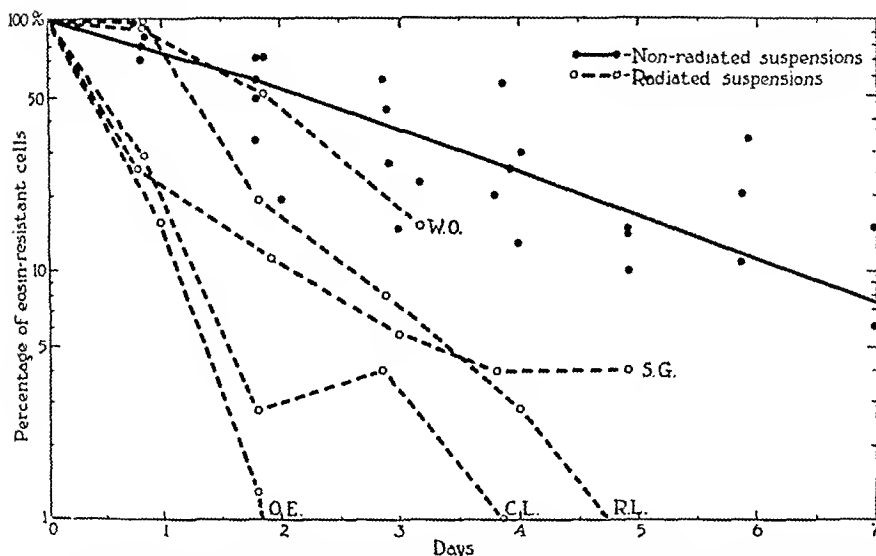


Fig. 13. Number of eosin-resistant cells in irradiated (1,000 r) and non-irradiated suspensions of the blood cells from five patients with lymphocytic leukemia; suspensions incubated at 37° C. In four of the five experiments, the irradiated suspensions had definitely fewer eosin-resistant cells than the non-irradiated suspensions.

It seemed from these studies that *in vitro* irradiation with x-rays caused the destruction of the lymphocytes of human blood after a latent period of forty-eight hours. In contrast, eosinophils seemed resistant to radiation under the same conditions. The radiosensitivity of neutrophilic polymorphonuclear leukocytes was not determined, since relatively few of these cells survived incubation for three days at 37° C.

LYMPHOCYTIC LEUKEMIC BLOOD

The white blood cells from five patients with lymphocytic leukemia were studied for radiosensitivity by the method of unstained cell counts. Four patients had been irradiated for five to eighteen days with 360 to 2,800 r prior to bleeding for these tests. Three patients had been treated for lymphatic leukemia on previous admissions, with remission of the disease.

Approximately 20 c.c. of blood were drawn and 0.8 c.c. of a 10 per cent solution of sodium citrate was added to prevent coagulation. The blood was allowed to stand for thirty to sixty minutes. During this period, the red blood cells usually settled but the white cells remained suspended in the plasma. The supernatant

fluid with the leukocytes was removed and centrifuged. The precipitated cells were washed and resuspended as described for normal blood cells. The cellular suspensions were irradiated (1,000 r), an equal volume of human serum was added, and the irradiated and the control non-irradiated suspensions were incubated in the water bath. The suspension was examined daily by counts and smears. To permit representation of the five experiments on one graph, each unstained cell count was expressed as a percentage of the number of unstained cells in the original suspension. The results are shown in Figure 13.

The solid circles in the graph represent percentage of unstained cells in the non-irradiated suspension during seven days of incubation. It is seen that there was a gradual decline in the number of unstained cells. There was some variation in the results obtained with the different cellular suspensions. The variation was, however, not marked, especially when one considers that the cells were derived from five different patients and that the experimental error was fairly large.

The survival curves of the cells in the irradiated suspensions varied considerably. In one case (WO) the x-rays had no ap-

preciable effect on the survival of the cells, but in the four other cases irradiation decreased markedly the number of viable cells. The number of patients studied was too small to determine the factors responsible for the variations in the radiosensitivity of the cells.

It may be concluded from these findings

first suspension prepared and 13 cells in a later experiment), the relative number of mature and immature leukocytes, and the amount of radiation previously received by the patient. In spite of these differences and in spite of a rather large experimental error, there was fairly good consistency in the number of unstained cells

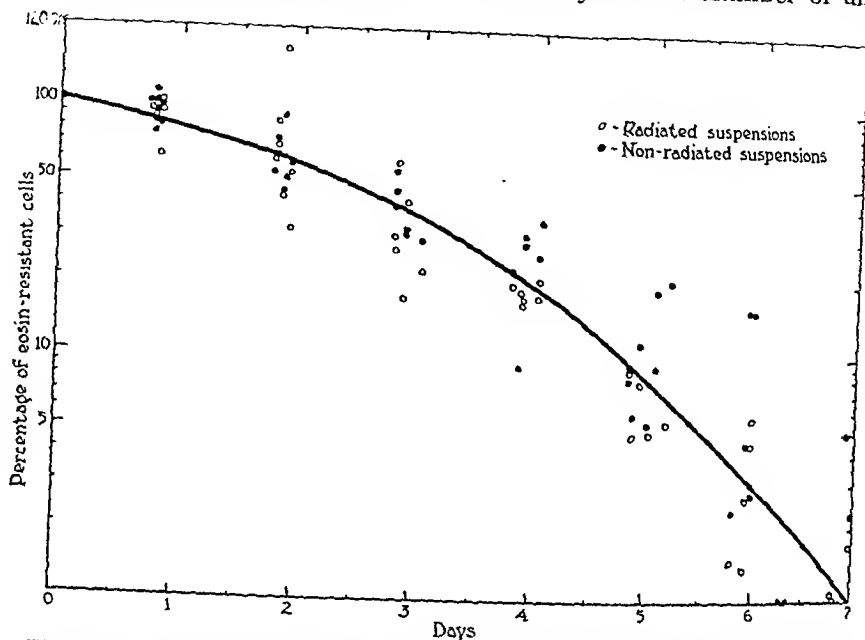


Fig. 14. Number of eosin-resistant cells in irradiated (1,000 r) and non-irradiated suspensions of the blood cells from seven patients with myelogenous leukemia; suspensions incubated at 37° C. The figure is plotted on semilogarithmic graph paper. Irradiation had little if any effect on the survival of the cells.

that the radiation killed the cells obtained from the blood of 4 out of 5 patients with lymphatic leukemia.

MYELOGENOUS LEUKEMIC BLOOD

The leukocytes of the blood from seven patients with myelogenous leukemia were prepared in suspension as described previously for cells of lymphocytic leukemia. Examination of the suspensions in a hemacytometer indicated that many of the cells had a tendency to flatten themselves against the glass and to become almost transparent. These cells were probably polymorphonuclear leukocytes.

Figure 14 shows the unstained cell counts of irradiated and non-irradiated suspensions during an incubation period of seven days. The suspensions differed in several respects, such as number of erythrocytes (158 cells per millimicroliter in the

in the non-irradiated suspension during seven days of incubation (Fig. 14).

A comparison of Figures 13 and 14 shows that there is a definite difference in the survival of the cells in suspensions derived from patients with the two types of leukemia, the cells of lymphocytic leukemia surviving for a longer period than the cells of myelogenous leukemia.

It is seen in Figure 14 that there was little or no difference between the percentage of unstained cells in the irradiated and the non-irradiated suspensions of myelogenous leukemic cells. In one case, the cells were exposed to 5,000 r, but even this dose of radiation had no appreciable effect. It seemed from these studies that radiation had no direct effect on the survival of myelogenous leukemic cells in suspension.

Smears of suspensions after incubation for three to six days showed that both the

irradiated and the non-irradiated suspensions had a small to moderate number of myelocytes and myeloblasts. These cells stained satisfactorily with hematoxylin and eosin or with Wright's stain, and had been presumably viable in the suspension. In comparison to the cells in the original suspension before incubation, the persisting

made (1) to check the accuracy of the previous conclusions which were obtained by inspection of graphs, (2) to derive a formula for the survival of cells, (3) to determine quantitatively the effect of radiation on cells, and (4) to measure the capacity of different types of cells to survive *in vitro*.

It was found that the data on the sur-

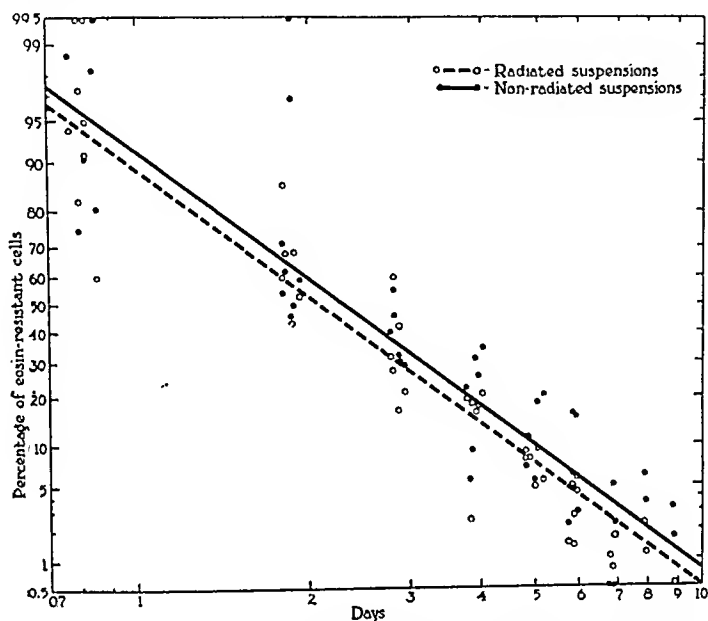


Fig. 15. Data of Figure 14 plotted on logarithmic-probability graph paper. The straight lines in the figure have been fitted by the method of least squares. The use of logarithmic-probability paper is advantageous, since the data can be represented by a straight line. The constants, the 50 and the 10 per cent survival time, can be determined from the graph.

cells were somewhat small; they had small nuclei and there was a relative increase in the ratio of cytoplasm to nucleus. These morphologic changes suggest that the immature myeloblasts and myelocytes had undergone an aging process but had failed to mature to polymorphonuclear leukocytes. A similar process was observed in suspensions of normal bone marrow of rabbits. Apparently, the suspensions lacked certain constituents which were necessary for the maturation of myelocytes and myeloblasts.

MATHEMATICAL ANALYSIS OF THE SURVIVAL OF CELLS

A detailed mathematical analysis of the data obtained in these experiments was

vival of cells in suspension could be summarized by three constants: (1) the 50 per cent and (2) the 10 per cent survival time, which represent the time when the numbers of unstained cells are reduced to 50 and 10 per cent of the original unstained cell count, and (3) the coefficient of variability, which is a measure of the variability of the survival periods of the individual cells in the suspension. Any two of these constants suffice for a complete characterization of the survival of cells and for a quantitative determination of the effect of x-rays. Although the significance of these three constants is easily understood, their mathematical derivation and calculation are involved.

The customary graphic method of repre-

senting the effect of x-rays on cells is the use of time as abscissa and percentage of surviving cells as ordinate. Another method was used in Figure 14, where the logarithm of the percentage of eosin-resistant cells was used as ordinate and time as abscissa. The former graphic method yields an S-shaped curve; the latter, a curve concave to the abscissa. Neither method is suitable for mathematical analysis. It would be preferable to use a graph which permits the representation of the survival of cells by a straight line.

In Figure 15, the data on the myelogenous leukemic cells are shown on logarithmic-probability paper (21) with the logarithm of time as abscissa and a function of the percentage of unstained cell counts as ordinate. This function has been termed normal frequency deviation by Gaddum (22), probits by Bliss (23), and probability units by Schrek (21). Inspection of the scatter diagram in Figure 15 indicates that there is a linear correlation between the logarithm of time and the probability units of the percentage. It would seem then that the logarithmic-probability paper is the best graphic method for a mathematical analysis of the survival of cells.

The representation of the survival of cells by a straight line on logarithmic-probability paper indicates that the survival periods for the individual cells can be represented by a symmetrical logarithmic frequency distribution. The geometric mean of this distribution represents the time necessary to decrease the number of unstained cells to 50 per cent of the original number. This constant may therefore be designated the 50 per cent survival period.

The geometric standard deviation of the distribution is the antilogarithm of the slope of the line on the axis of ordinates in the graph (Fig. 15). The geometric standard deviation may also be called the coefficient of variability. A relative high constant of variability probably indicates (1) a heterogeneous mixture of several types of cells in the suspension, (2) marked differences in

the physiologic condition of the cells, or (3) a high experimental error.

Although the rectilinear curve in Figure 15 can be characterized completely by the 50 per cent survival time and the coefficient of variability, it is useful to use a third constant, the 10 per cent survival time. This may be defined as the time when 10 per cent of the original cells are still alive and 90 per cent of the cells have been killed by the reagent or the incubation. The 10 per cent survival time is not an independent constant but can be calculated directly from the 50 per cent survival time and the coefficient of variability.

To calculate the statistical constants, the regression equation, $y = a + bx$, was determined for the scatter diagram in Figure 15. The statistical constants could then be obtained by the formulae:

$$50\% \text{ survival time} = \text{antilog} \left(-\frac{a}{b} \right)$$

$$\text{Geometric standard deviation} = \text{antilog} \left(-\frac{1}{b} \right)$$

$$10\% \text{ survival time} = \text{antilog} \left(-\frac{a + 1.28155}{b} \right)$$

The graphical derivation of the statistical constants was more convenient than the calculation and was frequently sufficiently accurate. The data were plotted as in Figure 15. A straight line was drawn through the points. The intersections of the line with the 50, 34.1, and 10 per cent ordinates were noted (c , d , and e , respectively). The constants were then calculated by the formulae:

$$50\% \text{ survival time} = \text{antilog } c$$

$$10\% \text{ survival time} = \text{antilog } e$$

$$\text{Geometric standard deviation} = \text{antilog}(d - c)$$

In conclusion, the survival *in vitro* of irradiated and non-irradiated cells was represented graphically by a straight line on logarithmic-probability paper. The data on the survival of cells were sum-

varized by the 50 per cent survival period (or geometric mean), the 10 per cent survival period, and by the constant of variability (or geometric standard deviation). By means of these three constants, the effect of various factors on the survival of cells was measured quantitatively.

constants for the leukemic cells were calculated arithmetically and for the other cells graphically.

It is seen from the figure that the thymic and splenic cells had relatively short 50 per cent survival periods (0.90 and 0.87 days, respectively) and short 10 per cent survival

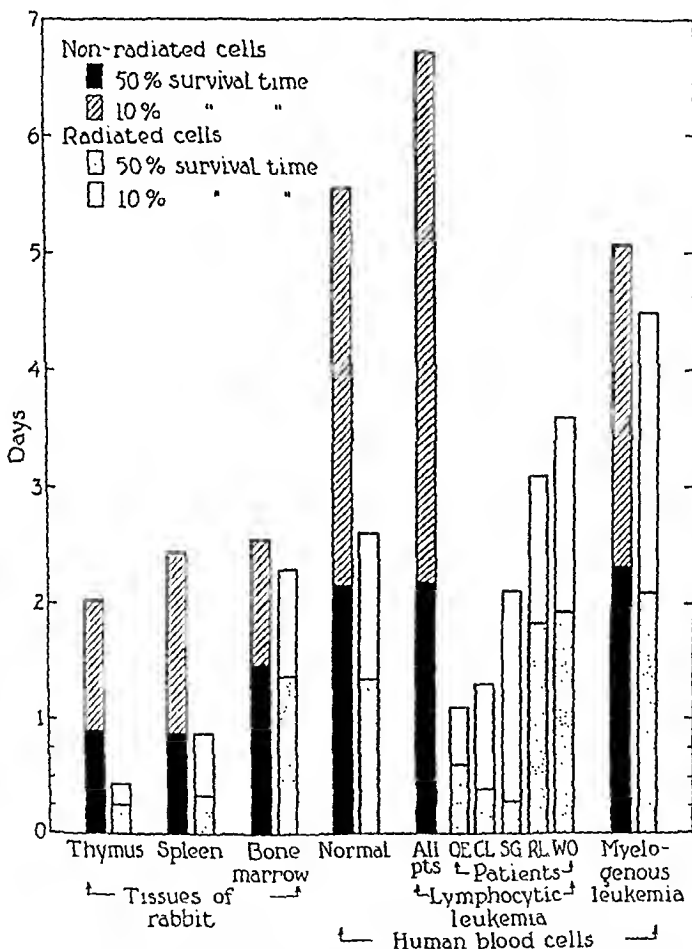


Fig. 16. The 50 and 10 per cent survival time of irradiated (1,000 r) and non-irradiated cells in suspensions derived from various organs. Irradiation decreased the survival period of cells in suspensions derived from the thymus and spleen of the rabbit and from normal and lymphocytic leukemic blood cells. Irradiation had no significant effect on cells from bone marrow and from myelogenous leukemic blood.

A COMPARISON OF THE SURVIVAL PERIODS OF DIFFERENT TYPES OF CELLS

The data on the survival of different types of suspensions were analyzed by graphic representation on logarithmic-probability paper and by calculation of the 50 and 10 per cent survival periods and the coefficient of variability. The results are summarized in Figure 16. The statistical

periods (2.02 and 2.42 days). The cells of the bone marrow had slightly longer 50 and 10 per cent survival times (1.48 and 2.55 days). The leukocytes of normal, lymphocytic, and myelogenous leukemic blood had the longest 50 per cent (2.16, 2.18, and 2.33 days, respectively) and 10 per cent survival periods (5.52, 6.67, and 5.08 days). Although the cells of lympho-

cytic leukemia had approximately the same 50 per cent survival time as those of myelogenous leukemia (2.18 and 2.33 days), the former had a considerably greater 10 per cent survival time (6.67 and 5.08 days).

In previous experiments (18) a study was made of the survival of cells in suspensions maintained at 45° C. It was found that the 10 per cent survival periods were 3.4 hours for thymic cells and 5.4 hours or more for normal and leukemic blood cells. It is seen that at both 37° and 45° C. the leukocytes of normal and leukemic blood survived a much longer period than thymic cells.

THE EFFECT OF RADIATION ON THE SURVIVAL OF CELLS

The present method of mathematical analysis permits the quantitative determination of the effect of radiation on cells. The 50 and 10 per cent survival time for the untreated thymic cells was 0.90 and 2.02 days (Fig. 16). In contrast, irradiated cells had a 50 and 10 per cent survival period of only 0.26 and 0.43 day. Similarly, the cells in suspensions from spleen and from normal and lymphocytic leukemic blood had, after irradiation, a much shorter 10 per cent survival period (0.88, 2.60, and 1.09 to 3.58 days) than the corresponding cells without radiation (2.42, 5.52, and 6.67 days). In contrast, the granulocytes from bone marrow and myelogenous leukemic blood had approximately the same 10 per cent survival periods in irradiated (2.27 and 4.50 days) and in non-irradiated suspensions (2.55 and 5.08 days).

It has been seen that the logarithmic-probability paper is useful to represent the effect of time of incubation on the percentage of unstained cell counts when the dosage of radiation is kept constant. The logarithmic-probability paper is useful also to determine the effect of varying dosage of radiation when time is kept constant. In fact, Bliss and Packard (24) used this graphic method to study the effect of radiation on the eggs of *Drosophila*.

TABLE II: EFFECT OF X-RAYS ON AEROBIC AND ANAEROBIC SUSPENSIONS OF LYMPHOCYTIC LEUKEMIC BLOOD CELLS INCUBATED AT 37° C.

	No. of Cells per Millimicroliter	Eosin-Resistant Cells per Millimicroliter
	Suspension Irradiated with 1,000 r	Suspension Not Irradiated
Before incubation	...	158
20 hours incubation		
Anaerobic suspension	112	...
Aerobic suspension	41	106
44 hours incubation		
Anaerobic suspension	93	84
Aerobic suspension	2.4	109

In the present investigation, Figure 5 was reconstructed on logarithmic-probability paper and the dosages of radiation corresponding to 50 and 10 per cent survival were found graphically. Thymic cells incubated for twenty-four hours showed 50 and 10 per cent survival when irradiated with 100 and 310 r, respectively.

EFFECT OF ANAEROBIOSIS ON RADIOSENSITIVITY

Several factors have been studied in preliminary experiments to determine whether they have any effect on the susceptibility of lymphocytes to x-rays. The results obtained with the cells under anaerobic conditions were of particular interest.

Pieces of glass tubing (14 cm. in length and 4 mm. in external diameter) with short pieces of rubber tubing at both ends (4 cm. in length) were filled with suspensions of thymic cells of the rat and of lymphatic leukemic cells. The rubber tubing was then kinked at both ends and sealed by slipping over each end a short strip of rubber tubing (3 mm. in length). The anaerobic preparations were irradiated with 1,000 r at room temperature. were placed in a metal box in a water bath at 33° or 37° C., and were rotated at the rate of 40 revolutions per minute. The control preparations were non-irradiated anaerobic suspensions and irradiated and non-irradiated aerobic suspensions.

In a typical experiment with lymphocytic leukemic blood, the original suspension contained 158 eosin-resistant cells per millimicroliter (Table II). Under aerobic

conditions, the count decreased, after forty-four hours of incubation at 37° C., to 2.4 cells in the irradiated and to 109 in the non-irradiated suspensions. Under anaerobic conditions, the count decreased to 93 and 84 in the irradiated and non-irradiated suspensions, respectively. In his and other experiments, no appreciable differences were observed in the unstained cell counts in irradiated and non-irradiated suspensions under anaerobic conditions. It would appear that x-rays had no effect on lymphocytes under anaerobic conditions.

DISCUSSION

Following irradiation and incubation, lymphocytes obtained from the thymus, spleen, and normal and leukemic blood lost their resistance to staining with eosin in suspension and acquired degenerative morphologic changes in stained smears. The observed changes in irradiated and incubated lymphocytes indicated strongly that these cells were dead. It would seem then that x-rays had a delayed cytotoxic action on lymphocytes.

Stenstrom, King, and Henschel (9) found, by means of tissue culture, that a dosage of 20 r caused a minimal decrease in the outwandering of cells from cultures of a lymph node. In the present investigation, it was observed that irradiation with as little as 50 r caused a slight but definite decrease in the unstained cell count in cellular suspensions derived from the thymus. Stenstrom's investigations by means of tissue culture and the present work by the method of unstained cell counts are in agreement that a small dose of radiation caused a physiologic change in lymphocytes.

It was observed by the method of unstained cell counts that x-rays in doses up to 5,000 r had no apparent effect on the granular leukocytes of bone marrow and on the cells of myelogenous leukemic blood. Osgood (10), on the other hand, found that irradiation of cultures of human bone marrow caused a decrease in the number of cells as compared to non-irradiated cul-

tures. It should be noted that different methods were employed in the present and in Osgood's experiments and that the biologic phenomena studied were different. In Osgood's cultures of bone marrow, many cells were in mitotic division, and the effect of radiation was attributed to an interference or inhibition of mitosis. In the present suspensions of bone marrow, the survival of cells, and not their mitotic activity, was studied. It would seem then, from Osgood's and from the present experiments, that irradiation decreased the mitotic activity of the cells of bone marrow but did not have a direct cytotoxic action on these cells.

SUMMARY AND CONCLUSIONS

Technical Methods: Cellular suspensions were prepared from the thymus, spleen, bone marrow, and testes of rabbits and from the leukocytes of normal and leukemic blood of men. The suspensions were irradiated with 20 to 5,000 r and incubated at 37° C. for one to seven days. The irradiated and control, non-irradiated suspensions were examined at periodic intervals by the method of unstained cell counts and by stained smears.

Mathematical Methods: The survivals of irradiated and of non-irradiated cells in suspension were represented graphically by a straight line on logarithmic-probability graph paper. The survival of cells was measured by two statistical constants: (1) the 50 per cent survival time and (2) either the 10 per cent survival time or the coefficient of variability. By means of these constants, it was possible to compare quantitatively the capacity of different types of cells to survive *in vitro* and to measure accurately the effect of irradiation on the survival of cells.

Findings: Exposure of thymic and splenic suspensions to 1,000 r caused no perceptible change in the number of eosin-resistant, *i.e.*, viable, cells in the first three hours of incubation but produced a relatively rapid decrease in the unstained cell counts after the short latent period. In smears of thymic suspensions subjected to

1,000 r and incubated aerobically for twenty-four hours, most of the cells were poorly stained and apparently degenerated, but many of the cells in non-irradiated suspensions stained satisfactorily. Irradiated leukocytes from normal blood and from lymphocytic leukemic blood had a shorter survival period than non-irradiated cells. Irradiation and incubation of suspensions from bone marrow, from myelogenous leukemic blood, and from the testicle had no effect on the number of eosin-resistant or viable cells when compared to non-irradiated suspensions. In contrast to the findings under aerobic conditions, radiation produced no perceptible decrease in the number of eosin-resistant lymphocytes which were irradiated and incubated in the absence of air.

Conclusions: Irradiation with x-rays had a delayed cytotoxic action on lymphocytes but no appreciable action on granulocytes and testicular cells *in vitro*. The cytotoxic action of radiation on lymphocytes was observed under aerobic but not under anaerobic conditions.

Veterans Administration
Hines, Ill.

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EDITORIAL

Acta Radiologica

The return of *Acta Radiologica* to our book shelves is one of the welcome results of the restoration of communications with Europe. Although the journal was published regularly during the war years, retaining its vigor, refreshing originality, and scientific eminence, it was unavailable to Americans until recently. Now that the issues of the past five years have arrived, it is evident that they contain a mine of information about developments in radiology during the war period; a thorough perusal of these volumes is most rewarding.

Acta Radiologica has a notable history. It was founded in 1921 as the organ of the Scandinavian Radiological Societies, but soon came to represent Holland and Switzerland as well as Sweden, Norway, Denmark, and Finland. The editors adopted the plan which is uniform in all the Actas, that is, the publication of articles in English, French, or German, with summaries of each in all three languages. Thus it has been read with considerable facility throughout the world, and the high standard of its contents has fully justified the attention it has received. The editorship has been from the beginning in the hands of Professor Gösta Forssell, and the numerous friends of that illustrious and beloved radiologist will rejoice to learn that he is still editing the journal. The character of the latest volumes bears testimony to the fact that his high ideals and wise leadership still dominate its pages. Perhaps the best monument which this most eminent of living radiologists will leave is the journal which he did so much to found and so much to develop.

It is good to note that the excellent

typography and the superb illustrations which have characterized the journal are still intact. It is easy to imagine what sacrifices must have been entailed in keeping up such a high standard both of format and of content. The editors and publishers are to be congratulated on the achievement of such a task.

The gracious custom of issuing birthday volumes, a characteristic Scandinavian tradition, is well illustrated in the issues for 1941 to 1945. Three such commemorative numbers were published during that period. The first, appearing at the end of 1941, is in honor of the fiftieth birthday of Erik Lysholm, now Chief of the Radiology Department at the Serafimer Hospital and Associate Professor of Radiology at the Royal Caroline Institute in Stockholm. While Doctor Lysholm is best known in this country for the invention of the stationary wafer grid, he is responsible for many other technical developments and for one of the most comprehensive studies of the roentgen anatomy and pathology of the skull and its contents. The issue honoring him is replete with papers whose quality is consistent with his original and inventive mind.

The second birthday volume, which is even larger, was issued in November of 1944 in honor of the sixtieth birthday of Hugo Laurell, Professor of Radiology at the University of Uppsala. Those who have known Laurell personally will appreciate fully the esteem in which he is held by his Scandinavian colleagues. From his fertile mind has issued much of our present knowledge concerning the value of roentgen procedures in the acute abdominal conditions. He was the first to describe adequately the roentgenologic findings in

peritonitis and in certain types of intestinal obstruction. From his original work came the development of the double-contrast enema. He was one of the first to study the effects of the respiratory movements on the heart and large vessels and the changes which result from fluid in the pleural cavities and from various other abnormalities. A physiologist of distinction, Laurell has devoted much thought to the demonstration of abnormalities in the physiology of the thorax by the roentgen method. Unfortunately, because many of his original papers were published in the *Uppsala Läkareforeningen* rather than in *Acta Radiologica*, his contributions have not been as familiar to Americans as they deserved. This volume pays fitting tribute to his numerous accomplishments.

The final issue in this group of birthday volumes is dedicated to P. Flemming Møller's sixtieth birthday. Doctor Møller,

Professor of Radiology at the University of Copenhagen and one of the original editors of the *Acta*, has been responsible for a great deal of the development and teaching of radiology in Denmark. This issue contains nineteen articles, of which all but three are in English.

All of the volumes contain such a variety of papers that it is impossible to recount their contents or even comment briefly upon their importance. Abstracts are appearing currently in *RADIOLOGY* and a number of the valuable Supplements are reviewed in the present issue.

The contributions of *Acta Radiologica* have enriched medicine for many years. *RADIOLOGY* extends greetings to this sister publication, with the earnest wish that it may be permitted to maintain its high standards and to continue to be available for the education of radiologists throughout the world.

LEO G. RIGLER, M.D.

Cystic Fibrosis of the Pancreas

With the increasing knowledge of certain disease processes and the accumulation of data by various investigators, many conditions that were previously discovered only at the postmortem table are now being diagnosed in the living with relative frequency. Among these is cystic fibrosis of the pancreas. While this has been accepted as a clinical entity, actually it is in most instances a part of a generalized process consisting in fibrosis and insufficiency of the pancreas, glandular involvement, and chronic lung changes. These last, demonstrable roentgenographically, may establish the diagnosis.

The work of Andersen (1) and of Blackfan and May (3) in 1938 did much to familiarize the medical profession with cystic disease of the pancreas as a disease entity. Their reports were the forerunners of a fairly numerous series by other workers who have added further details to our knowledge of the condition and the widespread changes associated with it.

The etiology has not yet been satisfactorily established. Some have regarded the pancreatic changes as of congenital origin, but this theory has not met with general acceptance. A familial tendency has, however, been recorded by a number of observers. The disease is essentially one of early infancy, the average age of onset in one series of 35 cases (3) being two months, with death at eight months. Some patients survive longer, in which event a diagnosis of "celiac disease" is usually made.

When death ensues shortly after birth, there is usually intestinal obstruction by thick mucilaginous meconium—so-called meconium ileus. If the child survives beyond this period, symptoms of chronic respiratory disease may so dominate the picture that the underlying condition may be missed entirely. In children living to six months or longer, the celiac syndrome—emaciation, abdominal distention, large fatty stools—becomes more obvious. At

the same time the pulmonary changes persist and may be the immediate cause of death.

Attwood and Sargent (2) have given an excellent description of the associated pulmonary lesions in cystic fibrosis of the pancreas. These consist, essentially, in a purulent bronchitis with bronchiectatic abscess formation and surrounding pneumonia. The roentgen picture is one of infiltration throughout both lungs, decreasing toward the periphery, the greatest density occurring over the hilar areas. These changes suggest a chronic or subacute process rather than an acute one. Neuhauser (4), in a paper published in this issue of RADIOLOGY, recognizes two stages of pulmonary involvement: a pre-infection stage, which is characterized by emphysema and atelectasis secondary to obstructing phenomena, and a second stage of superimposed infection with the changes described above. Neuhauser gives, also, an excellent description of the roentgen features of meconium ileus associated with

pancreatic insufficiency. With their aid, he was able to diagnose correctly 4 out of 10 cases coming to his attention.

With the better understanding of the disease made possible by the studies cited above and with greater familiarity with the roentgen findings in the chest and abdomen, as set forth by Attwood and Sargent, Neuhauser, and others, the ante-mortem diagnosis of fibrocystic disease of the pancreas should be made with increasing frequency.

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ANNOUNCEMENTS AND BOOK REVIEWS

RADIOLOGICAL SOCIETY OF NORTH AMERICA

The Thirty-second Annual Meeting of the Radiological Society of North America will be held at the Palmer House, Chicago, Ill., Dec. 1 to 6. The Refresher Courses will open on Dec. 1, and the General Sessions on Dec. 2.

AMERICAN BOARD OF RADIOLOGY EXAMINATIONS

The American Board of Radiology will conduct examinations at the Palmer House, Chicago, Nov. 27 to Dec. 1, 1946. This will be the only examination held during 1946. All those wishing to appear before the Board at this time must have their applications on file by Sept. 1, 1946.

B. R. KIRKLIN, M.D.
Mayo Clinic, Rochester, Minn.

THE ORLEANS PARISH RADIOLOGICAL SOCIETY

On Nov. 8, 1945, at a Roentgen celebration dinner, the radiologists of the New Orleans area formed a local radiological society to be known as the Orleans Parish Radiological Society. Dr. Lucien A. Fortier was elected president and Dr. Joseph V. Schlosser (Charity Hospital of Louisiana at New Orleans, New Orleans 13), secretary. Meetings are to be held on the first Tuesday of each month throughout the year.

PENNSYLVANIA RADIOLOGICAL SOCIETY

The next Annual Meeting of the Pennsylvania Radiological Society will be held on May 17 and 18 at the Berkshire Hotel, Reading, Penna.

LIGUE NATIONALE BELGE CONTRE LE CANCER

A request for radiological literature dealing with the cancer problem has been received from the National Belgian Cancer Society. "We beg to inform you," the letter reads, "that our association created, some years ago, a library especially devoted to the problems of cancer, which is at the disposal of the four schools of medicine of Belgium. As we were much deprived of any American medical or radiological literature during the war, we should be very glad if you would send to that library all works dealing with the cancer question published either by your Society or its members."

Such literature, including reprints, should be addressed: Ligue Nationale Belge contre le Cancer, Secrétariat-General, Rue des Deux-Eglises, 21, Bruxelles.

In Memoriam

LLOYD BRYAN, M.D.

Radiology lost one of its pioneers and successful practitioners when Lloyd Bryan died on Dec. 21, 1945. The tumor which finally brought about his end had caused a long, confining illness. Throughout the latter half of his life Dr. Bryan had suffered several illnesses through which he had come with fortitude to reoccupy his place as a leading roentgenologist in the San Francisco area.

Lloyd Bryan was born in Fortuna, Calif., on April 19, 1884. He had his academic and medical training at the University of California, from which he was graduated in 1911. He married Alice Downes of San Francisco in 1912 and spent the next four years in Eureka, as a general practitioner. Returning to San Francisco, he took a post-graduate course in roentgenology at Stanford Medical School in 1916 and then became associated with the late Howard Ruggles in the practice of radiology, which association endured until 1936. During his professional career in San Francisco, Dr. Bryan was connected with various hospitals at various times, as St. Mary's Hospital, Children's Hospital, and the University of California Hospital. His most continuous service was to the Dante Hospital, the Mt. Zion Hospital, and the San Francisco County Hospital. Dr. Bryan was a member of the faculty of the University of California Medical School for many years, being Associate Clinical Professor of Radiology at the time of his death.

Dr. Bryan was not a prolific writer but did contribute several articles to the medical journals of this country. He was a member of various societies, reaching the peak of his professional career when he was made President of the Radiological Society of North America in 1935. He was a member of his county and state medical associations and a fellow of the American Medical Association. He was a diplomate of the American Board of Radiology, a member of the Pacific Roentgen Society, the American Roentgen Ray Society, the Radiological Society of North America, and the American College of Radiology.

Dr. Bryan will long be remembered not only by his fellow radiologists but by all those with whom he came in contact. He is survived by his widow, Mrs. Alice Downes Bryan; by a daughter, now Mrs. John Martin Hanlon; a son, Dr. John Ruggles Bryan; and five grandchildren.

LT. COMDR. CECIL CHARLES WELCH, U.S.N.

Announcement has been received from the Chief of Naval Personnel of the death of Lt. Comdr. Charles Cecil Welch in a Japanese prison camp on



LLOYD BRYAN, M.D.
1884-1945

Dec. 15, 1944. Lt. Comdr. Welch received his early education in South Dakota. He was transferred from the South Dakota Medical School in 1925 to Northwestern Medical School and received his degree in medicine from that institution in 1928. He served his internship in the Navy Hospital, Boston, Mass., and his medical career was spent in the Navy. The Radiological Society of North America, of which he was a member, recognizes with pride his service to his country.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

SELECTED PAPERS FROM THE ROYAL CANCER HOSPITAL (FREE) AND THE CHESTER BEATTY RESEARCH INSTITUTE. Vol. III, 1941-1942, comprising reprints of articles from various journals. A volume of 321 pages. Price 16/-.

STUDIEN ÜBER EINIGE BIOLOGISCHE WIRKUNGEN DER RÖNTGEN- UND γ -STRAHLEN, INSBESONDERE AM PHYCOMYCES BLAKESLEEANUS. By ARNE G. FORSSBERG. Supplementum XLIX to *Acta Radiologica*. A volume of 143 pages, including 68 figures and tables. Published by P. A. Nordstedt & Söner, Stockholm, 1943.

Book Reviews

It has been the practice of *Acta Radiologica* in years past to publish from time to time monographs dealing with various subjects of radiologic interest. A number of these appearing during the war years have only recently reached the editorial offices of RADIOLOGY. It is with pleasure that we devote the Book Review section in this issue to some of these publications.

HYSTERO-SALPINGO-PELVIGRAPHIE. By SVEN ROLAND KJELLBERG. Supplementum XLIII to *Acta Radiologica*. A volume of 179 pages, with 177 illustrations. Published by P. A. Nordstedt & Söner, Stockholm, 1942.

To the series of useful monographs published as Supplements to *Acta Radiologica*, Dr. Sven Roland Kjellberg of the Department of Roentgenology of the Caroline Hospital, Stockholm, has added the present volume on Hysterosalpingography. The text is in German but an adequate English summary is appended, and numerous illustrations tell their own story even to those whose knowledge of the language is limited.

The book opens with a historical review of contrast studies of the uterus and tubes, including an interesting list of some of the materials which have

been used for that purpose in the last thirty-five years. The author's own material consisted of 213 cases examined in the Caroline Hospital from Nov. 20, 1940, to Feb. 28, 1942, chiefly with the aid of 50 per cent perabrodil. The examination, as he describes it, consists of two parts: first, a study of the uterine cavity and the tubal lumen; second, a study of the external contours of the pelvic organs, the thickness of the uterine wall, and the appearance of the minor pelvis. For the second part the contrast solution is diluted by an equal amount of water. Only 4 complications were seen in the entire series.

Following the discussion of anatomical considerations and the technic, are descriptions of the roentgen pictures of the normal organs and the changes incident to disease. A comprehensive bibliography, international in its scope, is appended.

THE MUSCULAR BUILD AND MOVEMENTS OF THE STOMACH AND DUODENAL BULB, ESPECIALLY WITH REGARD TO THE PROBLEM OF THE SEGMENTAL DIVISIONS OF THE STOMACH IN THE LIGHT OF COMPARATIVE ANATOMY AND EMBRYOLOGY. By JOHAN TORGENSEN. Supplementum XLV to *Acta Radiologica*. A volume of 191 pages, with 116 illustrations. Published by Fabritius & Sönners, Oslo, 1942.

The first part of this monograph on the structure and movements of the stomach is devoted to an excellent historical review with special emphasis on the roentgenologic studies of Forssell and the investigations of Pernkopf, who approached the subject from the point of view of embryonic development. The author has used still another method, studying the muscular structure of the stomach in specimens obtained from man and various animal species and hardened in formalin. He deals with the gastric regions separately, recording the structure, comparative anatomy, external shape, and forms of movement for each. Excellent diagrams of the various segments of the stomach are presented, showing that in reality it is a complex organ. This, in large measure, explains the functional changes, which otherwise are not easily understandable.

THE VALUE OF THE BARIUM ENEMA IN THE DIAGNOSIS AND TREATMENT OF INTUSSUSCEPTION IN CHILDREN, ILLUSTRATED BY ABOUT FIVE HUNDRED DANISH CASES. By JENS MUNCK NORDENFOT. Supplementum LI to *Acta Radiologica*. A volume of 94 pages of text and 35 plates. Published by Einar Munksgaard, Copenhagen, 1945.

This monograph, the 51st of the supplements to *Acta Radiologica*, is a study of the diagnosis and treatment of intussusception in children by the use of the barium enema. It is based directly upon observations in 440 cases from Danish hospitals, though the author's experience extends beyond these so that he is able to claim knowledge of some 1,000

cases. Since the paper was summarized in a regular issue of *Acta Radiologica* and has been abstracted in *RADIOLOGY* (45: 633, 1945), its contents need not be further reviewed here.

A series of 35 plates, including 118 figures showing cases of all types, is appended to the text and there is a full bibliography.

RENAL TUBERCULOSIS AND ROENTGENOLOGIC EXAMINATION. A SURVEY AND A COMPARISON BETWEEN THE EFFICIENCY OF THE DIFFERENT DIAGNOSTIC METHODS IN SIXTY CASES OF SURGICAL RENAL TUBERCULOSIS, WITH A SPECIAL VIEW TO THE ROENTGENOLOGIC DIAGNOSTIC. By RAGNAR STEINERT. Supplementum LIII to *Acta Radiologica*. A volume of 162 pages, with reproductions of 35 roentgenograms, 3 graphs, and 8 tables. Published by Grondahl & Sønns, Oslo, 1943.

The subtitle of this monograph on the roentgen diagnosis of renal tuberculosis as carried out in the Ullevål Municipal Hospital, Oslo, indicates adequately its scope. In the first part the historical aspects of the subject are considered, together with the various types of examination and their attendant problems. In the second part the author presents his results with intravenous and retrograde pyelography. He concludes that intravenous urography cannot replace the retrograde method unconditionally but that both may be necessary, together with inoculation and culture, to obtain an early diagnosis of tuberculosis. A detailed summary of 60 cases is included. A voluminous bibliography is appended.

CEREBRAL ANGIOGRAPHY WITH PERABRODIL (CAROTIS ANGIOGRAPHY). By ARNE ENGESET. Supplementum LVI to *Acta Radiologica*. A volume of 207 pages, with 68 illustrations. Published by Fabritius & Sønners, Oslo, 1942.

This monograph from the Roentgenologic and Neurological Departments of the University Clinic of Oslo is based on a study of 100 patients on whom cerebral angiography was performed, with 35 per cent perabrodil, introduced intra-arterially, as the contrast medium. In the series were 56 cerebral tumors, of which 47 were localized by angiography. In 14 cases there were pathologic changes in the vascular supply of the tumor and in 33 cases there was vascular displacement. There were discovered, also, 5 saccular aneurysms and 3 of the arteriovenous variety. Thrombosis of the carotid and subdural hematoma may also be demonstrated. Sixty-eight case histories are included, with numerous illustrations.

Those interested in cerebral angiography will find this a valuable study.

URETHROCYSTOGRAPHY IN THE MALE WITH SPECIAL REGARD TO MICTURITION. By NILS P. G. EDLING. Supplementum LVIII to *Acta Radiologica*. A volume of 144 pages, with 66 illustrations. Published by P. A. Norstedt & Söner, Stockholm, 1945.

At the Roentgen Diagnostic Clinic of the Karolinska Sjukset, from which this monograph comes, examination of the lower urinary tract has taken the form of urethrocytography, based on concurrent filling of the urethra and bladder with contrast material. The earlier practice was to make retrograde studies only, but since 1940 these have been supplemented by examination during micturition. The author has made a critical analysis of the relative value of these two methods in the study of normal and pathologic conditions of the bladder and urethra, concluding that micturition studies form an important complement to the retrograde method and that if the greatest amount of information is to be gained both should be employed.

ON CANCER OF THE BREAST, WITH SPECIAL REFERENCE TO THE RESULTS OF DIFFERENT METHODS OF TREATMENT. By STURE RÖDÉN. Supplementum LVII to *Acta Radiologica*. A volume of 50 pages, with 42 tables. Published by P. A. Norstedt & Söner, Stockholm, 1945.

This small but useful monograph comes from the First Surgical Clinic of the Caroline Institute, Stockholm. The author surveys the results of treatment of carcinoma of the breast by (1) surgery alone, (2) surgery and postoperative irradiation, and (3) preoperative irradiation, surgery, and postoperative irradiation combined. He cites the results of surgeons and radiologists, both American and European, and presents his own material. The difficulty of making comparisons is mentioned and it is rightly stated that indisputable conclusions cannot be drawn from comparisons of this sort.

The author's series consists of 343 cases. These patients were uniformly operated upon; the follow-up reached 99 per cent, and histologic diagnosis was obtained in more than 97 per cent of the number. The five-year survival rate for the entire series was 46.9 per cent. The author concludes that the best results are obtained by use of surgery with preoperative and postoperative irradiation. The statistical analysis is detailed, and much other interesting and related information is contained in the monograph.

RADIOLOGICAL SOCIETIES OF NORTH AMERICA

Editor's Note.—Will secretaries of societies please cooperate by sending information to Howard P. Doub, M.D., Editor, Henry Ford Hospital, Detroit 2, Mich.

UNITED STATES

Radiological Society of North America.—Secretary, D. S. Childs, M.D., 607 Medical Arts Bldg., Syracuse 2, N. Y.

American Roentgen Ray Society.—Secretary, Harold Dabney Kerr, M.D., Iowa City, Iowa.

American College of Radiology.—Secretary, Mac F. Cahal, 20 N. Wacker Dr., Chicago 6, Ill.

Section on Radiology, American Medical Association.—Secretary, U. V. Portmann, M.D., Cleveland Clinic, Cleveland 6, Ohio.

ARKANSAS

Arkansas Radiological Society.—Secretary, J. S. Wilson, M.D., Monticello. Meets every three months and annually at meeting of State Medical Society.

CALIFORNIA

California Medical Association, Section on Radiology.—Secretary, Gordon King, M.D., Children's Hospital, San Francisco.

Los Angeles County Medical Association, Radiological Section.—Secretary, Roy W. Johnson, M.D., 1407 South Hope St., Los Angeles. Meets second Wednesday of each month at County Society Building.

Pacific Roentgen Society.—Secretary, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually with California Medical Association.

San Diego Roentgen Society.—Secretary, Henry L. Jaffe, M.D., U. S. Naval Hospital, San Diego, Calif. Meets first Wednesday of each month.

San Francisco Radiological Society.—Secretary, Joseph Levitin, M.D., 516 Sutter St., San Francisco 2. Meets monthly on the third Thursday at 7:45 P.M., first six months of the year in Lane Hall, Stanford University Hospital, and second six months in Toland Hall, University of California Hospital.

COLORADO

Denver Radiological Club.—Secretary, A. Page Jackson, Jr., M.D., 304 Republic Bldg., Denver 2. Meetings third Friday of each month, Denver Athletic Club.

CONNECTICUT

Connecticut State Medical Society, Section on Radiology.—Secretary, Max Climan, M.D., 242 Trumbull St., Hartford 3. Meetings bimonthly, second Thursday.

FLORIDA

Florida Radiological Society.—Secretary-Treasurer, J. F. Pitman, M.D., Blanche Hotel Annex, Lake City.

GEORGIA

Georgia Radiological Society.—Secretary-Treasurer, James J. Clark, M.D., 478 Peachtree St., N. E., Atlanta 3. Meets in November and at the annual meeting of State Medical Association.

ILLINOIS

Chicago Roentgen Society.—Secretary, Fay H. Squire, M.D., 1753 W. Congress St., Chicago 12. Meets at the Palmer House, second Thursday of October, November, January, February, March, and April.

Illinois Radiological Society.—Secretary-Treasurer, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly by announcement.

Illinois State Medical Society, Section on Radiology.—Secretary, Frank S. Hussey, M.D., 250 East Superior St., Chicago 11.

INDIANA

The Indiana Roentgen Society.—Secretary-Treasurer, Harold C. Ochsner, M.D., Methodist Hospital, Indianapolis 7. Annual meeting in May.

IOWA

The Iowa X-ray Club.—Secretary, Arthur W. Erskine, M.D., Suite 326 Higley Building, Cedar Rapids. Holds luncheon and business meeting during annual session of Iowa State Medical Society.

KENTUCKY

Kentucky Radiological Society.—Secretary-Treasurer, Sydney E. Johnson, M.D., 101 W. Chestnut St., Louisville.

LOUISIANA

Louisiana Radiological Society.—Secretary-Treasurer, Johnson R. Anderson, M.D., North Louisiana Sanitarium, Shreveport. Meets annually at same time as State Medical Society.

Shreveport Radiological Club.—Secretary, Oscar O. Jones, M.D., 2622 Greenwood Road. Meets monthly September to May, third Wednesday, 7:30 P.M.

MARYLAND

Baltimore City Medical Society, Radiological Section.—Secretary, Charles N. Davidson, M.D., 101 West Read St., Baltimore 1.

MICHIGAN

Detroit X-ray and Radium Society.—Secretary-Treasurer, E. R. Witwer, M.D., Harper Hospital, Detroit 1. Meetings first Thursday of each month from October to May, at Wayne County Medical Society club rooms.

Michigan Association of Roentgenologists.—Secretary, Bruce MacDuff, M.D., 201 Sherman Bldg., Flint 3.

MINNESOTA

Minnesota Radiological Society.—Secretary, A. T. Stenstrom, M.D., Minneapolis General Hospital, Minneapolis 26. Meetings quarterly.

MISSOURI

Radiological Society of Greater Kansas City.—Secretary, John W. Walker, M.D., 306 E. 12th St., Kansas City, Mo. Meetings last Friday of each month.

St. Louis Society of Radiologists.—Secretary, Edwin C. Ernst, M.D., 100 Beaumont Medical Bldg. Meets on fourth Wednesday of each month except June, July, August, and September.

NEBRASKA

Nebraska Radiological Society.—Secretary-Treasurer, Donald H. Breit, M.D., University of Nebraska Hospital, Omaha 5. Meetings third Wednesday of each month at 6 P.M. in either Omaha or Lincoln.

NEW ENGLAND

New England Roentgen Ray Society.—Secretary-Treasurer, George Levene, M.D., Massachusetts Memorial Hos-

pitals, Boston, Mass. Meets monthly on third Friday at Boston Medical Library.

NEW HAMPSHIRE

New Hampshire Roentgen Society.—Secretary-Treasurer, Richard C. Batt, M.D., St. Louis Hospital, Berlin.

NEW JERSEY

Radiological Society of New Jersey.—Secretary, H. R. Brindle, M.D., 501 Grand Ave., Asbury Park. Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called.

NEW YORK

Associated Radiologists of New York, Inc.—Secretary, William J. Francis, M.D., East Rockaway, L. I.

Brooklyn Roentgen Ray Society.—Secretary-Treasurer, Leo A. Harrington, M.D., 880 Occan Ave., Brooklyn 26. Meets fourth Tuesday of every month, October to April.

Buffalo Radiological Society.—Secretary-Treasurer, Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meetings second Monday evening each month, October to May, inclusive.

Central New York Roentgen Society.—Secretary-Treasurer, Carlton F. Potter, M.D., 425 Waverly Ave., Syracuse 10. Meetings in January, May, and October.

Long Island Radiological Society.—Secretary, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meetings fourth Thursday evening each month at Kings County Medical Bldg.

New York Roentgen Society.—Secretary, Wm. Snow, M.D., 941 Park Ave., New York 28.

Rochester Roentgen-Ray Society.—Secretary, Murray P. George, M.D., 260 Crittenden Blvd., Rochester 7. Meets at Strong Memorial Hospital, third Monday, September through May.

NORTH CAROLINA

Radiological Society of North Carolina.—Secretary-Treasurer, Major I. Fleming, M.D., 404 Falls Road, Rocky Mount. Meets in May and October.

NORTH DAKOTA

North Dakota Radiological Society.—Secretary, Charles Heilman, M.D., 1338 Second St., N., Fargo.

OHIO

Ohio Radiological Society.—Secretary, Henry Snow, M.D., 1061 Reibold Bldg., Dayton 2. Next meeting at annual meeting of the Ohio State Medical Association.

Cleveland Radiological Society.—Secretary-Treasurer, Carroll C. Dundon, M.D., 11311 Shaker Blvd., Cleveland 4. Meetings at 6:30 P.M. on fourth Monday of each month from October to April, inclusive.

Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists).—Secretary-Treasurer, Samuel Brown, M.D., 707 Race St., Cincinnati 2. Meetings held third Tuesday of each month.

PENNSYLVANIA

Pennsylvania Radiological Society.—Secretary-Treasurer, L. E. Wurster, M.D., 416 Pine St., Williamsport 8. The Society meets annually.

Philadelphia Roentgen Ray Society.—Secretary, Calvin L. Stewart, M.D., Jefferson Hospital, Philadelphia 7. Meets first Thursday of each month at 8:00 P.M., from October to May, in Thomson Hall, College of Physicians, 21 S. 22d St.

Pittsburgh Roentgen Society.—Secretary-Treasurer, Lester M. J. Freedman, M.D., 4800 Friendship Ave., Pittsburgh 24. Meets second Wednesday of each month at 6:30 P.M., October to May, inclusive, at The Ruskin, 120 Ruskin Ave.

ROCKY MOUNTAIN STATES

Rocky Mountain Radiological Society (North Dakota, South Dakota, Nebraska, Kansas, Texas, Wyoming, Montana, Colorado, Idaho, Utah, New Mexico).—Secretary, A. M. Popma, M.D., 220 North First St., Boise, Idaho.

SOUTH CAROLINA

South Carolina X-ray Society.—Secretary-Treasurer, Robert B. Taft, M.D., 103 Rutledge Ave., Charleston 16.

TENNESSEE

Memphis Roentgen Club.—Chairmanship rotates monthly in alphabetical order. Meetings second Tuesday of each month at University Center.

Tennessee Radiological Society.—Secretary-Treasurer, J. Marsh Frère, M.D., 707 Walnut St., Chattanooga. Meeting annually with State Medical Society in April.

TEXAS

Dallas-Fort Worth Roentgen Study Club.—Secretary, X. R. Hyde, M.D., Medical Arts Building, Fort Worth 2. Meetings on third Monday of each month, in Dallas in the odd months and in Fort Worth in the even months.

Texas Radiological Society.—Secretary-Treasurer, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth 4.

VIRGINIA

Virginia Radiological Society.—Secretary, E. Latané Flanagan, M.D., 215 Medical Arts Bldg., Richmond 19.

WASHINGTON

Washington State Radiological Society.—Secretary-Treasurer, Thomas Carlile, M.D., 1115 Terry Ave., Seattle. Meetings fourth Monday of each month, October through May, at College Club, Seattle.

WISCONSIN

Milwaukee Roentgen Ray Society.—Secretary-Treasurer, C. A. H. Fortier, M.D., 231 W. Wisconsin Ave., Milwaukee 3. Meets monthly on second Monday at the University Club.

Radiological Section of the Wisconsin State Medical Society.—Secretary, S. R. Beatty, M.D., 185 Hazel St., Oshkosh. Two-day annual meeting in May and one day in connection with annual meeting of State Medical Society in September.

University of Wisconsin Radiological Conference.—Meets first and third Thursdays, 4 to 5 P.M., September to May, inclusive, Room 301, Service Memorial Institute, 426 N. Charter St., Madison 6.

CANADA

Canadian Association of Radiologists.—Honorary Secretary-Treasurer, J. W. McKay, M.D., 1620 Cedar Ave., Montreal.

La Société Canadienne-Française d'Electrologie et de Radiologie Médicales.—General Secretary, Origène Dufresne, M.D., Institut du Radium, Montreal. Meets on third Saturday of each month.

CUBA

Sociedad de Radiología y Fisioterapia de Cuba.—Offices in Hospital Mercedes, Havana. Meets monthly.

ROENTGEN DIAGNOSIS

The Head and Neck

- SCHNEIDER, MARTIN. Aerosinusitis: A Clinico-Roentgenological Study..... 422
- ÅKERLUND, ÅKE, AND WELIN, SÖLVE. Roentgen Diagnosis of Malignant Tumors within the Boundary Region Between the Pharynx and Esophagus..... 422
- NØRGAARD, FLEMING. Arthrography of the Mandibular Joint..... 422
- SCHWARTZ, CHARLES W. Solitary Myeloma of the Frontal Bone..... 422
- HINCHEY, JOHN J., AND BICKEL, WILLIAM H. Fracture of the Atlas: Review and Presentation of Data on Eight Cases..... 422

The Chest

- WESTERMARK, NILS. On the Influence of the Intra-Alveolar Pressure on the Normal and Pathological Structure of the Lungs..... 422
- MCGRIGOR, D. B., AND SAMUEL, ERIC. Radiology of War Injuries: Part III. War Wounds of the Chest..... 423
- STUART, F. G. Pathological Manifestations and Anatomical Variations in Pre-Enlistment Chest Roentgenograms..... 424
- TUBERCULOSIS IN WORLD WAR II (Symposium)..... 424
- KINZER, RICHARD E. The Chest X-Ray Examination: Analysis of Disqualifying Conditions Found Among 105,141 Selectees..... 424
- SCATCHARD, GEORGE N., AND DUSZYNSKI, DIANA O. Miniature Chest X-Ray Films in General Hospitals..... 425
- GOULD, DAVID M. Nontuberculous Lesions Found in Mass X-Ray Surveys..... 425
- PISZCZEK, EDWARD A. Tuberculosis, a New Post War Public Health Problem..... 425
- DORMER, B. A., FRIEDLANDER, J., AND WILES, F. J. Bronchography in Pulmonary Tuberculosis: A Geographical Adventure..... 425
- CAMEL, MORTIMER R. Roentgenology of the Massive Conglomerate Lesions of Silicosis... 425
- NORDENSKJÖLD, JAN. Case of So-Called Lung Cyst, Apparently a Subpleural Interstitial Airspace..... 426
- ODQVIST, HENNING. Studies on the Roentgen Findings in Intracardiac and Particularly Perimitral Calcifications..... 426
- GRISHMAN, A., AND KANE, I. J. Disseminated Calcified and Bony Nodules in the Lungs Associated with Mitral Disease..... 426
- AXÉN, OLIVER, AND LIND, JOHN. Roentgenologic Determination of Heart Volume in Infants... 426

The Digestive System

- HARDT, LEO L., HUFFORD, A. RAY, AND RABENS, J. I. Analytical Survey of 1,132 Patients Gastroscopecally Examined..... 426

- SANDSTRÖM, CARL. On Gastrosplasm and Its Roentgenologic Appearance..... 427
- POLLARD, H. MARYIN, AND COOPER, RALPH R. Hypertrophic Gastritis Simulating Gastric Carcinoma..... 427
- RIGLER, LEO G., KAPLAN, HENRY S., AND FINK, DANIEL L. Pernicious Anemia and the Early Diagnosis of Tumors of the Stomach... 427
- HUDSON, PERRY B., GAY, LENDALL C., AND NEWMAN, HOWARD E. Pneumothorax Resulting from a Dissecting Gastric Ulcer..... 428
- LODER, HORACE B., AND KORNBLUM, STANLEY A. Duodenal Ulcer in a Large Army Camp..... 428
- GRÄBERGER, GÖSTA. Case of Trichobezoar..... 428
- HELLMER, HANS. Intussusception in Children: Spontaneous Reduction and the Sources of Error in Its Diagnosis..... 428
- FRIMANN-DAHL, J. On Strangulating Obstruction of the Small Bowel with Special Reference to Cases with Poor Roentgen Findings.. 428
- BILLING, LARS. Technic of Contrast Examination of the Sigmoid Colon..... 428
- HOLMGREN, BENGT S. Case of Fluoroscopically Reduced Sigmoid Volvulus..... 428
- BAGLEY, W. R., AND BAGLEY, E. C. Stenosis of the Sigmoid in the Newborn..... 429
- LINDQUIST, GÖSTA. Cases of Intermittent Colon Invagination on the Basis of Tumor..... 429
- CLAUSEN, ARNE. Unusual Case of Pure Colon Invagination..... 429
- EHRENPREIS, TH. Megacolon in the Newborn... 429
- MELAMED, A., AND FELD, S. M. Luetic Rectal Stricture..... 429
- MORALES, OLALLO. Calcified Appendices Epiploicae as Freely Mobile Bodies in the Abdominal Cavity..... 429

The Lesser Peritoneal Sac

- MORRISON, M. C. Radiological Findings in Lesser Sac Effusions..... 430

The Small Pelvis

- WALLDÉN, LENNART. On the Roentgen Diagnosis of Space-Restricting Processes in the Small Pelvis..... 430

The Musculoskeletal System

- COVENTRY, M. B., GHORMLEY, R. K., AND KERNOHAN, J. W. The Intervertebral Disc: Its Microscopic Anatomy and Pathology... 431
- CHILDE, ARTHUR E. Role of the X-Ray in the Diagnosis of Posterior Herniation of the Intervertebral Disc..... 431
- KNUTSSON, FOLKE. Instability Associated with Disk Degeneration in the Lumbar Spine.... 432
- MALMBERG, NILS. Occurrence and Significance of Early Periosteal Proliferation in the Diaphyses of Premature Infants..... 432

RIBBING, S. Etiology of Osteochondrosis Dissecans..... 433

DOCKERTY, MALCOLM B., GHORMLEY, RALPH K., KENNEDY, ROGER L. J., AND PUGH, DAVID G. Albright's Syndrome (Polyostotic Fibrous Dysplasia with Cutaneous Pigmentation in Both Sexes and Gonadal Dysfunction in Females)..... 433

COLEY, BRADLEY L., AND STEWART, FRED W. Bone Sarcoma in Polyostotic Fibrous Dysplasia..... 433

HERMODSSON, IVAN. Different Types of Osteoarthritis in the Hip Joint and Their Connection with the Anatomical Conditions. Does There Exist Any Subluxation Coxae Acquisita?..... 433

LINDBLOM, KNUT. Subcostal Swelling of the Soft Tissues in Osteochondritis..... 434

JORUP, SIGVARD. Case of Chondrodystrophia Congenita Calcificans..... 434

SEAR, H. R., AND MADDOX, J. K. Case of Hurler's Disease (Lipochoondrodystrophy)..... 434

GOODMAN, S. J. Identical Twins: Achondroplastic Dwarfs..... 435

Gynecology and Obstetrics

DUFRESNE, ORIGENE. Value of Hysterosalpingography in Diagnosis of Gynecological Affections..... 435

MATLAND, D. G. Radiology of Pelvic Types and Their Obstetrical Significance..... 435

FRECKER, ERIC W. Pelvic X-Ray Measurements and Pelvic Contraction..... 435

The Genito-Urinary Tract

BELL, JOSEPH C., HEUBLEIN, GILBERT W., AND HAMMER, HOWARD J. Roentgen Examination of the Urinary Tract with Special Reference to Methods of Examination and Findings in Individuals with Testicular Tumors.. 435

ECHTERNACHT, ARTHUR P. Injuries of the Urinary Tract: Roentgenological Considerations..... 436

KICKHAM, CHARLES J. E. Obstruction of the Ureter in Children..... 436

Technic

FUCHS, ARTHUR W. Military Photoroentgen Technique Employing Optimum Kilovolt (Peak) Principles..... 437

GARLAND, LEO H., AND HARRIS, MILO T. Wet-Film X-Ray Viewing Room..... 437

RADIOTHERAPY

Neoplastic Disease

ENGELSTAD, ROLF BULL, AND WEYDE, ROLF. Adenofibrosis Mammac. The Norwegian Radium Hospital's Material 1932-1942..... 437

HEYMAN, J. On Improving the Results of Treatment in Cancer of the Collum of the Uterus.. 437

DEAN, ARCHIE L. Wilms' Tumors..... 438

HOLLAND, C. A. Multiple Carcinomas. Four Consecutive Primary Carcinomas with Apparent Cure..... 438

JANSSON, GÖSTA. Roentgen Treatment and the Course of Cure of Giant Cell Tumour in the Osseous System..... 438

LINDGREN, ERIK. Research with Radioactive Isotopes in the Treatment of Leukemia..... 438

Non-Neoplastic Disease

PORTMANN, U. V., AND LOUGH, ROGER. Roentgen Therapy for Acute Encephalitis..... 439

FREEDMAN, LESTER M. J., AND BEINHAUER, LAWRENCE G. Roentgen-Ray Treatment of Tinea Capitis..... 439

Technic

EDLING, LARS. Experiences with Roentgen Rotation Therapy..... 439

FARMER, F. T. Condenser Ionization Chambers for Measurement of X-Rays in Body Cavities: Physical Problems in Their Design.... 439

KEMP, L. A. W. A New Circuit with Special Applications in Gamma-Ray and X-Ray Dosimetry..... 439

BENNER, SVEN. Defects in Roentgen Tubes Demonstrated by Gamma-Ray Photographs. 439

CLEPHAN, DOROTHY F. A Technique for Autoradiographs of Radium Containers..... 439

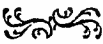
Effects of Radiation

HENSHAW, PAUL S. Implications from Studies with Physical Carcinogens..... 440

EXPERIMENTAL STUDIES

FOX, CHARLES L., JR., AND KESTON, ALBERT S. Mechanism of Shock from Burns and Trauma Traced with Radiosodium..... 440

RUSS, S., AND SCOTT, G. M. Resistance to Tumour Grafts Produced by a Cell-Free Tumour Extract..... 440



ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Aerosinusitis: A Clinico-Roentgenological Study. Martin Schneider. *Am. J. Roentgenol.* 53: 563-572, June 1945.

Aerosinusitis is a distinct clinical entity closely allied to aero-otitis media. It occurs during descent from altitude in an aircraft or altitude chamber. It is characterized clinically by a sudden, severe, unremitting pain localized over the region of the affected sinus. It is thought that the pain is due to sudden stretching and separation of the mucoperiosteum following the developing of high negative pressure as a result of plugging of the ostium by a mucous plug or other cause. Roentgenograms demonstrate the mucoperiosteal swelling and may show the presence of fluid, which can be either a simple transudate or a hematoma. Without an adequate history, the roentgen appearance is hardly distinguishable from the changes seen in acute allergic or infective sinusitis.

L. W. PAUL, M.D.

Roentgen Diagnosis of Malignant Tumors Within the Boundary Region Between the Pharynx and Esophagus. Åke Åkerlund and Sölve Welin. *Acta radiol.* 25: 883-911, Nov. 21, 1944. (In English.)

Roentgen demonstration of malignant tumors within or adjacent to the entrance of the esophagus is possible at a stage when laryngoscopic findings are still negative. Any patient, therefore, in whom such a tumor is even slightly suspected should have the advantage of roentgen studies. This method of examination is simple and harmless, without inconvenience to the patient. It permits an evaluation of the depth of the lesion in the pharyngo-esophageal wall and thus furnishes valuable information for the planning and application of radiotherapy. It also assists in the early diagnosis of possible regional recurrences.

From Feb. 1, 1940, to May 1, 1944, 48 patients with cancer in the region between the pharynx and esophagus were examined in the Department of Diagnostic Roentgenology at the Caroline Hospital, Stockholm. In 29 of these cases, the laryngoscopic findings were either completely normal or at least not sufficiently characteristic to warrant a clinical diagnosis of tumor. In 28 of these cases, roentgenography furnished conclusive evidence of a neoplastic growth even on the first examination. The roentgenologic appearance, technic, symptomatology, and differential diagnosis are described in detail.

Arthrography of the Mandibular Joint. Flemming Nørsgaard. *Acta radiol.* 25: 679-685, Nov. 21, 1944. (In English.)

The author describes the technic employed in 34 instances of mandibular arthrography (in 28 patients) with the aid of an aqueous iodine solution as a contrast medium.

Solitary Myeloma of the Frontal Bone. Charles W. Schwartz. *Am. J. Roentgenol.* 53: 573-574, June 1945.

A case is reported of solitary myeloma of the skull occurring in association with Paget's disease. This is the seventh case recorded in the literature of skull involvement by this tumor. The patient, a 42-year-old

female, complained of indefinite headache for four years. Roentgen examination showed the characteristic changes of Paget's disease. There also was a sharply circumscribed area of rarefaction in the left posterior frontal bone. The biopsy diagnosis of this lesion was a giant-cell myeloma. Roentgen therapy was given, a total of 1,274 r in eight days. The mass gradually regressed and the defect filled in with bone.

L. W. PAUL, M.D.

Fracture of the Atlas: Review and Presentation of Data on Eight Cases. John J. Hinchey and William H. Bickel. *Ann. Surg.* 121: 826-832, June 1945.

The authors cite 112 cases of fracture of the atlas, including 8 of their own. In 50, the lesion was an isolated one, involving the atlas alone, while in 62 it was complicated by other injuries, such as fractures of the vertebrae or skull. The mortality rate was 10.7 per cent.

Fractures of the atlas are almost always due to trauma to the top of the head when the spine is in a neutral position. The site of predilection is the posterior arch, since this is weakened by the grooves for the vertebral arteries while the occipital condyles, facing posterolaterally, tend to splay the atlas out in those directions. The anteroposterior view may show a gap in the anterior arch, as well as an outward displacement of the lateral masses, while the lateral view readily demonstrates fractures of the posterior arch. Swelling of the soft tissues in the prevertebral space may mean fracture of the anterior arch, while an increase of the distance between the anterior arch and the odontoid process may indicate rupture of the transverse ligament or dislocation.

Treatment consists of traction followed by application of a plaster encasement or a leather collar. In the 8 cases reported by the authors, the posterior arch alone was fractured in 5 cases, the posterior and anterior arches were fractured in 2, and the articular facet was fractured in the remaining case. Two cases were complicated by fractures of additional bones. The results were classed as excellent in 3 cases, good in 2, fair in 2, and poor in one. There were no deaths in this group.

ELLWOOD W. GODFREY, M.D.

THE CHEST

On the Influence of the Intra-Alveolar Pressure on the Normal and Pathological Structure of the Lungs. Nils Westermark. *Acta radiol.* 25: 874-882, Nov. 21, 1944. (In English.)

On comparing pulmonary roentgenograms taken under normal pressure with those obtained at low pressure, it is found that the films taken at a low pressure demonstrate a considerably increased filling of the vessels in the lungs, an increased structure, and a larger cardiac volume. Roentgenograms taken under high pressure, on the other hand, when compared with films taken under normal pressure, show a considerable reduction in the filling of the vessels and a diminution in their structure and in the cardiac volume. Films taken under high pressure reveal a definite difference in pulmonary stasis, pulmonary edema, and in acute pulmonary changes. By routinely taking chest films under normal and high pressures, therefore, a more exact and

safer diagnosis can be made in such conditions. In chronic inflammatory conditions and tuberculosis there are no changes, or at least none so striking as in acute conditions.

At the St. Göran Hospital, where 1,500 persons with pulmonary changes have now been examined by this method, a water manometer is used, employing a normal pressure of -5 to -10 cm. water. Immediately before the film is taken, the patient is told to make a light inspiration and then to suck through the mouth-piece until the level of the liquid falls so that there results a pressure of -5 to -10 cm. water. To obtain films exposed at a low pressure, inspiration is augmented until a low pressure of -40 cm. water is reached. To obtain pictures with high pressure, the patient must press the water level of the manometer up to 40 cm. These are the pressures employed in routine examinations. If on any occasion another pressure is used, this is indicated separately.

Radiology of War Injuries. Part III. War Wounds of the Chest. D. B. McGrigor and Eric Samuel. Brit. J. Radiol. 18: 133-145, May 1945.

In modern warfare the radiological investigation of chest wounds falls into two main classes. In the *forward areas* the examination is usually confined to scout films to give a general estimation of the intrathoracic damage. More complete studies, including fluoroscopy, are done at *base hospitals*. Periodic examinations during convalescence are most important, especially where re-expansion of the lung is being followed. A suggested radiological classification of chest injuries includes four main headings: non-penetrating injuries, penetrating injuries, emphysema, heart injuries.

Non-Penetrating Injuries: Fractures of the ribs usually occur as the result of anteroposterior compression, though below the seventh they may be due to muscular exertion. The fragments rarely penetrate the lungs. Rib fractures may be overlooked at the primary examination, and re-examination should be made in about ten days. Fractures of the spine, sternum, shoulder girdle, and scapula should always be looked for in chest injuries.

Extrapleural hematoma and edema of the chest wall may give rise to confusing shadows. They may follow any type of chest injury. They usually can be differentiated by the fact that the bronchovascular markings and the hilar shadow are undisturbed.

A segment of the chest wall, by reason of double fracture of the ribs, may become functionally detached from the rest of the wall, resulting in a "stove-in" chest. This produces symptoms similar to an open pneumothorax. Roentgenograms usually reveal a hemopneumothorax or a large hematoma of the chest wall. Considerable emphysema may occur. Massive collapse is sometimes observed.

Atelectasis most frequently follows bronchial obstruction either from mucus or blood. It may be segmental or total, depending upon the size of the bronchus occluded. Since stricture of the bronchus may follow, serial examinations are important.

Blast injuries produce mottling in the periphery and lower lung fields. Lobular and lobar collapse may also be present. There may be localized emphysema of the upper lobes. In simple cases clearing is observed in three days and the chest will appear normal in about ten. Hematomas in the lung may follow blast or other non-penetrating injuries. These are identified

as central opacities with ill-defined borders. Resolution takes place in six to eight weeks.

Mediastinal emphysema is serious when it is caused by rupture of a bronchus, but when secondary to spontaneous pneumothorax it is not significant. Engorgement of the vessels of the head and neck and of the pulmonary circulation is common, due to pressure on the veins. A lateral film reveals the air in the mediastinum, while a postero-anterior view shows a clear linear area along the lateral borders of the heart.

Traumatic asphyxia is seen after sudden compression of the chest. The clinical picture is characteristic. Radiographically lobular collapse of the lung may be observed. The condition usually follows a benign course. Retinal hemorrhages may be a serious complication.

Fat emboli following fracture of the larger bones may produce a bizarre appearance, multiple areas of density resembling bronchopneumonia, which disappear in a few days.

Penetrating Injuries: In the presence of foreign bodies radiology is used for their anatomical localization, for investigation of the pathological state with reference to surgical approach, and for the estimation of the damage along the track of the missile. Localization of a foreign body demands careful fluoroscopy. Tangential views are often useful. Foreign bodies in the heart may not be visible because of the motion. Foreign bodies more than 1 cm. in diameter should be removed because they are likely to carry with them infected material, such as parts of clothing.

Seventy-five per cent of the penetrating wounds of the chest are associated with hemothorax, and some 80 per cent of these cases become infected. The radiological signs are those of pleural effusion. The blood should not be left in the thorax for an undue length of time. Clotting or organization of a hemothorax is suggested by mottling, multiple fluid levels, thickening of the visceral pleura (if an associated pneumothorax is present), and mediastinal displacement toward the affected side.

Tension pneumothorax is readily diagnosed, though it may be confused with traumatic diaphragmatic hernia, large emphysematous bullae, and giant cysts of the lungs.

In abdomino-thoracic wounds rupture of the diaphragm is indicated by the invisibility of the dome either because of retraction of the sides of the tear or the presence of hemorrhage. At the screen intermittent twitching movements may be seen. There may be atelectasis with little blood in the pleural cavity. It is important in these wounds to know the point of entrance and exit of the missile. There are three main types of missile track demonstrable radiologically: a hollow track, a solid track, and a track marked by traces of metal.

Empyema: Empyema occurs in about 20 per cent of serious wounds of the thorax. In chronic cases over-penetrated and grid films are useful. Iodized oil may frequently aid in determining the size of the cavity. Tomography is useful for the same purpose.

Heart Injuries: Careful fluoroscopy is essential in localizing foreign bodies in the heart. The relation of the foreign body to the various motions of parts of the heart is important.

Death following chest injury may be due to "cardiac tamponade." In the acute type there is rapidly developing intrapericardial tension. An insidious

type may develop where there is a foreign body near the heart. The diagnosis can best be made fluoroscopically by the restriction or complete absence of pulsation. This should be looked for in all patients where the distress is out of proportion to the evidence of injury.

SYDNEY J. HAWLEY, M.D.

Pathological Manifestations and Anatomical Variations in Pre-Enlistment Chest Roentgenograms. F. G. Stuart. *Canad. M. A. J.* 52: 477-481, May 1945.

The author reports observations on 19,000 chest roentgenograms made during a forty-eight week period in 1943 on Canadian Army recruits (males) between eighteen and thirty-eight. Of this group, 6 per cent showed the calcified nodules of Ghon. These were found fairly equally distributed throughout both lung fields in contrast to the re-infection type of tuberculosis, which predominates in the upper thirds of the lung fields. By actual count, there was a larger number of these calcified nodules in the hilar areas than in the peripheral zones, indicating that some of the peripheral lesions had completely disappeared.

Re-infection type of tuberculosis was found in 237 or 1.3 per cent of the series and varied from minimal to far advanced lesions.

Obliteration of the costophrenic sinus was observed in 648 or 3.4 per cent. In the majority of these patients, no history of significant respiratory disease could be elicited. It was found, however, that obliteration of the costophrenic sinus occurred three and one-half times more frequently in those showing the calcified primary complex than in those that did not.

In 42 of the series, non-tuberculous atypical pneumonia was found, but none of this group had any clinical evidence of the disease. The infiltration in these cases was almost invariably in the lower half of the lung fields.

Studies of the cardio-thoracic ratio were also made. It was found that if the cardiac diameter did not exceed 50 per cent of that of the chest, the chances for cardiac disease are only one in seventy, but in those cases where the cardiac diameter exceeds 50 per cent, the chances for cardiac disability are one in two. Notation was also made of various congenital anomalies, and the ratios of these are given. Dextrocardia was noted in 4 cases, or one in 4,762. Other anomalies are listed, but are too numerous to mention here.

Finally, the author discusses technical positioning for chest radiography to study completely the upper part of each lung field. If questionable lesions are seen in routine projections, two additional exposures are made: one anteroposterior with the patient in the lordotic position, the primary beam being projected parallel to the plane of the first rib; the other postero-anterior with the beam angulated downward and the central ray projection through the apical area. By using a film blocker, both of these projections can be made on one 14 X 17-in. film, since the whole of such a film is not needed for either view.

BERNARD S. KALAYJIAN, M.D.

Tuberculosis in World War II (Symposium). Council on Military Affairs and Public Health, American College of Chest Physicians. *Dis. of Chest* 11: 266-281, May-June 1945.

This symposium, presented before the American College of Chest Physicians, consists of reports from

the medical government agencies on the problem of tuberculosis control.

Maj. Gen. Shelley U. Marietta, representing the Army, stated its problem as the elimination of those with tuberculosis and those with inactive lesions which might be re-activated under stress, and prevention of rejection of those with minimal lesions not considered hazardous. It was agreed that the most rapid and accurate method of deciding these factors was by means of properly taken and properly interpreted x-ray films of the chest. Arbitrary standards, based on x-ray findings, were set up for guidance for various boards of examiners. This resulted in a general rejection rate of 1 to 1.5 per cent of all men examined. Despite precautions, a considerable number of tuberculous individuals were inducted because of improper interpretations by inexperienced roentgenologists or other causes. The record, however, is not too bad, for the average admission rate for tuberculosis is 1 per 1,000; during World War I it was 11.8 per 1,000. This difference is attributable to the better methods now in use to discover cases.

Capt. Robert E. Duncan stressed the decreasing incidence of tuberculosis in the Navy and the extensive use of photofluorographic studies as a case-finding procedure in its tuberculosis control program.

Col. J. D. Adamson stated that over one and a half million prospective members of the Canadian forces have been x-rayed and examined for tuberculosis, a figure which represents 26 per cent of the male population and 63 per cent of males of army age. In 1 per cent significant disease was found.

Col. Roy A. Wolford, Assistant Medical Director of the Veterans' Administration, presented a statistical study of tuberculosis cases among World War II veterans. In all hospitals, through March 1944, admissions of tuberculous veterans having service after Dec 7, 1941; approximated 7,200, of which some 4,200 had been discharged, leaving almost 42 per cent of the World War II tuberculous veterans in the hospitals on March 31, 1944.

Dr. Joseph W. Post, speaking from the point of view of the radiologist, expressed his opinions based on experience with examination of army inductees and in a tuberculosis clinic in Philadelphia. He was enthusiastically in favor of mass surveys, favoring 35-mm. films, with conventional films for suspicious cases. The photofluorographic examinations are reliable, and early and minimal lesions are detectable when the films are viewed and interpreted by competent radiologists. Dr. Post objected to the evaluation of a tuberculous lesion on a mathematical basis, *i.e.*, the size of calcified nodes or the number of calcified foci in a given area. The importance and value of the screening process is attested to by the fact that tuberculosis, the chief cause of disabilities leading to discharge in World War I, dropped to tenth place in World War II.

Dr. Herman E. Hilleboe and Dr. David M. Gould of the U. S. Public Health Service discussed tuberculosis control in industry.

HENRY K. TAYLOR, M.D.

The Chest X-Ray Examination: Analysis of Disqualifying Conditions Found Among 105,141 Selectees. Richard E. Kinzer. *J. A. M. A.* 128: 499-502, June 16, 1945.

When the results of x-ray chest surveying of a sizable group of draftees were tabulated, it was found that 1.25 per cent of 105,141 persons were rejected for military

service because of abnormal chest findings. Rejections because of some form of tuberculosis as discovered by the x-ray survey represented 0.95 per cent of the total group examined. Among the tuberculosis cases, those with signs of minimal re-infections predominated, 526 of the 999 selectees who were rejected.

These figures once again illustrate the practical value of the x-ray screening process without presuming that any single method of examination will be found to be infallible. Unfortunately the notoriously poor quality of x-ray reproductions provided by the J. A. M. A. forced the author to use as illustrations only the more obvious examples of pulmonary disease.

The discussion of Major Kinzer's paper by Dr. Robert Bloch contains interesting arguments for the employment of fluoroscopy as a case-finding method. Not all radiologists will agree entirely with Dr. Bloch's views.

FRED JENNER HODGES, M.D.
(University of Michigan)

Miniature Chest X-Ray Films in General Hospitals. George N. Scatchard and Diana O. Duszynski. J. A. M. A. 127: 746-748, March 31, 1945.

An analysis of 3,000 consecutive chest roentgenograms taken at the Edward J. Mayer Memorial Hospital, Buffalo, during approximately two and one-half summer months, illustrates the importance of routine x-ray examination of the chest of every patient on admission. This figure includes follow-up studies and re-examinations as well as new admissions. Of the 3,000 examinations 1,070 (35.7 per cent) revealed significant lesions. Conventional films were used in 326 studies, miniature films in 2,721 (90.7 per cent), and a combination of the two methods in 47. During the period of this study 1,832 patients were admitted to the hospital and in this group 36 unsuspected cases of pulmonary tuberculosis were discovered by roentgenography. Twenty-six were from 725 new admissions, representing 3.6 per cent of unsuspected pulmonary tuberculosis. The authors believe that stereoscopic photoroentgenography is an economical and satisfactory method.

Nontuberculous Lesions Found in Mass X-Ray Surveys. David M. Gould. J. A. M. A. 127: 753-756, March 31, 1945.

The discovery of non-tuberculous pathologic changes has been a valuable by-product of mass surveys primarily intended for tuberculosis case finding in industry. An analysis of 442,252 chest films revealed a total of 4,982 cases (1.1 per cent) showing evidence of non-tuberculous chest disease. Sixty-six different lesions are listed according to the frequency of occurrence. A large proportion of abnormalities were unknown to the patients prior to the x-ray examination. The lesions are classified in three main categories: (1) chest abnormalities frequently resembling pulmonary tuberculosis; (2) chest abnormalities infrequently resembling pulmonary tuberculosis, including parenchymal lesions, mediastinal, pleural, and diaphragmatic lesions, cardiovascular lesions, systemic disease as evidenced on the chest film; (3) miscellaneous and bizarre findings.

Tuberculosis, a New Post War Public Health Problem. Edward A. Piscesek. Illinois M. J. 87: 284-291, June 1945.

The author discusses the public health and case-finding aspects of tuberculosis, particularly as they relate to

the state of Illinois. The death rate from tuberculosis has shown an increase during the war, as it did during and following World War I.

Illinois has lagged behind a number of other states in decline of tuberculosis during the period 1930-1942. This is attributed to shortage of sanatorium facilities and to inadequate case-finding surveys. More extensive survey of the population by x-ray examination, using 4 X 5-inch film, is advocated in order to discover more cases of tuberculosis in the minimal stages. Reference is made to the experience of the Armed Forces in examination of some 12 million inductees. Sixty per cent of the cases found by this method were in the minimal stage and did not require hospital treatment.

H. H. WRIGHT, M.D.

Bronchography in Pulmonary Tuberculosis: A Geographical Adventure. B. A. Dormer, J. Friedlander, and F. J. Wiles. Am. Rev. Tuberc. 51: 455-462, 519-526, May and June 1945.

This is the fourth paper in a series dealing with bronchography (the earlier ones are abstracted in Radiology 44: 603, 1945; 45: 412, 1945). It describes the appearance of the bronchial system in pulmonary tuberculosis. Experience has shown that tuberculosis is a disease which does its greatest harm to the bronchial system and that, even in early stages of the disease, irreparable damage may be done to the bronchial tree. Block of some portion of the bronchial system is invariably present in every case unless the area beyond the block has already broken down into a cavity. As a result of bronchial or bronchiolar block, there occurs cavitation or bronchiectasis and ultimately a distortion of the bronchial tree due to fibrosis. Tuberculous cavitation and bronchiectasis, therefore, arise in exactly the same way as does non-tuberculous bronchiectasis or pulmonary abscess.

Sixteen case reports are presented with reproductions of roentgenograms to illustrate these concepts. The cases include various pathologic types of pulmonary tuberculosis and demonstrate the use of bronchography in mapping the bronchial tree. Several cases of non-tuberculous bronchiectasis are included to show the similarity of the bronchial damage to that occurring in tuberculosis.

L. W. PAUL, M.D.

Roentgenology of the Massive Conglomerate Lesions of Silicosis. Mortimer R. Camiel. Am. Rev. Tuberc. 51: 527-531, June 1945.

In chest roentgenograms, the massive conglomerate lesions of silicosis are frequently confused with pulmonary cancer, infections, or atelectasis. There is, however, a group of these conglomerate silicotic lesions which produce so typical a roentgenologic picture that the diagnosis can be made from the roentgenogram alone. The basic appearance of the lung in this type of the disease is described as follows:

1. Subapical or subclavicular location of the lesions is most common; the process is often located in the apices of the lower lobes.
2. The lesions are almost invariably bilateral.
3. There is a tendency toward symmetry.
4. There is frequently a clear zone of emphysema surrounding the lesions and separating them from both the hila and the chest wall. The separation from the hila is an important sign, since it excludes at once lesions which might arise in the hilar lymph nodes, such as Hodgkin's disease.

5. Emphysema over the remainder of the lung fields is almost invariably present.

6. The position of the lesions is usually longitudinal. Gardner points out that they may lie at right angles to the ribs. The shapes of these lesions do not form standard patterns, as may be seen with neoplasms or infarction, but their longitudinal position is helpful in recognition.

7. Confirmatory typical nodulation may be present.

8. The lesions in the separate lung fields incline toward a similar density and appearance. With primary carcinoma or tuberculosis on one side with spread to the other, the appearance in the opposite lung field is different. The density may be much greater than with neoplasms.

9. Fibrous strands are frequently seen radiating outward from the lesions.

10. Diaphragmatic deformities are frequent. Limitation of diaphragmatic motion is common.

11. The trachea is usually in the mid-line.

Two cases are reported to illustrate these changes.

L. W. PAUL, M. D.

Case of So-Called Lung Cyst, Apparently a Subpleural Interstitial Airspace. Jan Nordenskjöld. *Acta radiol.* 25: 662-671, Nov. 21, 1944. (In German.)

The author reports a pulmonary cyst in a 7-year-old girl. The cyst, measuring $7.5 \times 7.5 \times 8.0$ cm., with a wall 1.0 mm. thick, in the left lower lobe, was an incidental finding during a respiratory infection. The sputum was negative for tuberculosis. On needling the cyst, clear yellow fluid was obtained containing pus cells and Gram-positive diplococci, but no tubercle bacilli. There was no change in status for about three years, but eventually an excision led to a bronchial fistula; finally a thoracoplasty was necessary. The patient was in good condition on discharge.

The author believes this was an interstitial subpleural emphysematous bleb developing as a result of whooping cough. He discusses at length the pathological physiology by which such a condition can be produced.

LEWIS G. JACOBS, M.D.

Studies on the Roentgen Findings in Intracardiac and Particularly Perimitral Calcifications. Henning Odqvist. *Acta radiol.* 25: 686-700, Nov. 21, 1944. (In German.)

Cardiac calcifications are fairly common, failure to demonstrate them more frequently on roentgenograms being due to technical factors. For a long time fluoroscopy was the only successful method but, with the development of high-speed techniques, film demonstration has become possible.

Mitral calcifications appear in two forms. In cases due to endocarditis, commonly found in younger patients, the calcification takes a rounded contour with a beaded configuration; when a single valve is involved, the structure may be coarsely streaky and patchy. In degenerative conditions the annulus calcifies in the shape of a horseshoe in the mitral region, particularly at the attachment of the posterior leaf. More rarely a ring is formed. Limited motion of the leaves indicates impaired cardiac action. This type of change is more common in people in the sixties.

The finding of these calcifications requires special fluoroscopic technic. The fluoroscopist must be perfectly

accommodated, preferably for over an hour, and must use great care in the search. The use of hard rays is advisable. Fluoroscopy in the sagittal direction demonstrates the calcifications more clearly. The use of such calcifications in the study of heart action is discussed, and some illustrative cases are recorded.

LEWIS G. JACOBS, M.D.

Disseminated Calcified and Bony Nodules in the Lungs Associated with Mitral Disease. A. Grishman and I. J. Kane. *Am. J. Roentgenol.* 53: 575-581, June 1945.

Eight cases of disseminated bony and calcific nodules in the lung occurring in association with mitral stenosis and insufficiency are reported. The pathogenesis of these lesions is unknown. The clinical histories suggest that they have their origin during rheumatic fever and the early lesions preceding calcification probably develop then. The calcific shadows may be insignificant in size and number and easily overlooked or may be extensive. They are found predominantly in the basal lung areas and vary considerably in size. They are apt to be called "healed miliary tuberculosis," but the authors believe this is infrequent and some doubt its existence altogether. Hematogenous dissemination of tuberculosis involves chiefly the upper lung fields. The final differentiation from tuberculosis is based upon the basal distribution of the lesions, absence of other tuberculous lesions elsewhere, and the presence of mitral stenosis and insufficiency.

L. W. PAUL, M.D.

Roentgenologic Determination of Heart Volume in Infants. A Preliminary Report. Oliver Axén and John Lind. *Acta paediat.* 32: 270-287, 1945. (In English.)

Roentgen determination of the heart volume was carried out in 45 infants with normal hearts. Films were taken simultaneously in two planes at right angles (the frontal and sagittal planes) and the volume computed by Jonsell's modification of the Kahlstorf formula (Jonsell: *Acta radiol.* 20: 325, 1939). With this method, the area of the frontal heart shadow is calculated by the formula for an ellipse.

In order to ascertain the error of the method, a number of control examinations were made on cadavers, and in addition double determinations were made in 18 infants at the time of the roentgen examination. The absolute values from the heart volume were correlated with the body length and the body weight, and the heart volume per square meter of body surface with the body length.

THE DIGESTIVE SYSTEM

Analytical Survey of 1,132 Patients Gastroscopically Examined. Leo L. Hardt, A. Ray Hufford, and J. I. Rabens. *Gastroenterology* 4: 477-483, June 1945.

During the period 1940-43, inclusive, 1,132 patients were examined gastroscopically one or more times in three institutions in Chicago. All of these patients had symptoms of gastroduodenal disease.

The stomach was found to be normal on gastroscopic examination in 439 (38.7 per cent) cases. Of this group, 244 were roentgenologically normal and 195 had x-ray findings indicative of duodenal ulcer. The gastroscopic and roentgen reports agreed on the absence of organic disease in 411 cases. In the remaining 28 patients, the roentgen diagnosis was indeterminate and indefinite

for gastric disease. Suggestions of pyloric deformity and possible carcinoma were made, but subsequent observations proved these diagnoses to be incorrect.

In 285 patients (24.8 per cent) a gastroscopic diagnosis of gastritis was made. Acute gastritis was diagnosed gastroscopically in 52 cases; the roentgen findings were normal in these patients. Atrophic gastritis was found on gastroscopic examination in 145 patients, and in 87 of these there was an evident vitamin deficiency. The roentgen findings were normal in 112 of the 145 cases, and in 25 a diagnosis of duodenal ulcer was made. Hypertrophic gastritis was diagnosed gastroscopically in 69 patients. Roentgenograms revealed hypertrophic changes in 2 of this group; the findings were reported as normal in 26 cases, indicative of duodenal ulcer in 19, and as showing a pyloric deformity or questionable gastric ulcer in 9.

Benign gastric ulcer was diagnosed clinically, roentgenologically, and gastroscopically in 193 patients. The diagnosis was made gastroscopically in 171 patients, and roentgenologically in 111. Fourteen patients had marginal (gastrojejunal) ulcers, as shown by the combined use of gastroscopy and roentgenology. The ulcer was visualized gastroscopically in 11 patients and roentgenologically in 6.

A diagnosis of gastric cancer was made in 136 patients. Of the 79 patients in whom a cancer was found on surgical exploration, the gastroscopic diagnosis proved correct in 73, the roentgen diagnosis in 61.

The gastro-enterostomy stoma of 34 gastro-enterostomized patients was visualized gastroscopically in 29 instances and roentgenologically in 30. Of 2 gastric diverticula demonstrated roentgenologically, only one was detected with the gastroscope. Gastric polyps were found gastroscopically in 11 patients; in 4 of these patients the roentgen diagnosis was a questionable carcinomatous lesion and in 3 a duodenal ulcer. Four roentgenograms were entirely normal.

Gastroscopic examination was incomplete or unsatisfactory, for various reasons, in 58 of the 1,132 patients.

On the basis of their experience, the authors conclude that gastroscopy is indicated (a) in all cases of persistent or recurrent gastric complaints with negative roentgen findings, in which gastric disease is still suspected; (b) in many cases of proved gastric ulcer where operation is not performed; (c) in cases where the x-ray findings indicate a suspicious gastric lesion or a definite diagnosis cannot be made; (d) in all cases of cancer of the stomach except those in which the lesion is located at the cardia or is well advanced.

On Gastropasm and Its Roentgenologic Appearance. Carl Sandström. *Acta radiol.* 25: 765-795, Nov. 21, 1944. (In English.)

The term gastropasm is used by the author to denote a functional tetanic cramp in the wall of the stomach due to the structure of the muscular coat, without evidence of organic change such as gastritis, ulcer, or tumor. Roentgenologically gastropasm is characterized by a more or less pronounced deformity of the stomach, of a retort- or cascade-type, with rigid contours. Gastric peristalsis is weakened or completely halted, the motility of the stomach is reduced, and the emptying time disturbed. Changes in the deformity during examination, with complete return

to normal upon subsequent control examination, are pathognomonic of the condition. The author discusses the roentgenological differential diagnosis of gastropasm and presents, on the basis of the roentgen anatomy of the stomach, a tentative anatomical explanation of the deformity. Etiology and therapy are also discussed. Four cases are presented.

Hypertrophic Gastritis Simulating Gastric Carcinoma. H. Marvin Pollard and Ralph R. Cooper. *Gastroenterology* 4: 453-465, June 1945.

While confusion between the roentgen manifestations of gastric carcinoma and those of a localized hypertrophic gastritis is rare, a number of cases are on record indicating that such a problem does exist.

During the past four years, at the University Hospital, Ann Arbor, Mich., roentgen examination of the stomach in 8 cases revealed a filling defect not distinguishable from cancer. All of the patients were males, ranging in age from twenty-two to sixty-five. In 5 of the 7 cases in which gastroscopy was done, a diagnosis of localized hypertrophic gastritis was established with reasonable certainty. The diagnosis of hypertrophic gastritis and the absence of neoplasm were confirmed in 7 of the 8 cases by laparotomy, and histologically in 6.

Since early diagnosis and treatment are essential in the management of gastric neoplasm and operation may be contraindicated in cases of hypertrophic gastritis, it seems important that all such cases be studied gastroscopically before surgery is undertaken. It is perhaps wiser not to depend on a trial of conservative therapy to establish the diagnosis.

Neither roentgen nor gastroscopic findings alone are sufficient to distinguish between localized hypertrophic gastritis of the lower regions of the stomach and annular neoplasm in that area.

[It is unfortunate that the roentgenograms which accompany this paper have no legends or dates and there are no references to them in the text, so that it is difficult in some instances to correlate them with the case histories.]

Pernicious Anemia and the Early Diagnosis of Tumors of the Stomach. Leo G. Rigler, Henry S. Kaplan, and Daniel L. Fink. *J. A. M. A.* 128: 426-432, June 9, 1945.

Roentgen examination of the stomach of 211 patients with pernicious anemia revealed a cancer in 8 per cent and benign polyps in 7.1 per cent of the cases. In approximately 20 per cent of the cases only one examination was made, usually at the time of the discovery of the anemia. In the remaining 80 per cent there were multiple examinations, usually semiannually but often at longer intervals. In some instances as many as eight roentgen examinations of the stomach were made. Pains were taken to reveal not only cancer but also benign polyps. In an autopsy series published elsewhere (*Am. J. M. Sc.* 209: 339, 1945) Kaplan and Rigler found 12.3 per cent of patients with pernicious anemia to have cancer of the stomach as well. The high incidence of cancer revealed by these studies indicates clearly an etiologic rather than an accidental relationship between pernicious anemia and gastric tumors.

The routine roentgen examination of the stomachs of patients with pernicious anemia has proved to be a

valuable procedure, resulting in some salvage of cancer cases which might otherwise not have been obtained. Cases illustrating the rapid change from a benign polyp to a cancer, the presence of benign and malignant tumors side by side, the absence of symptoms in the presence of large tumors, and the development from a small, barely detectable lesion to an extensive inoperable carcinoma were observed.

Pneumothorax Resulting from a Dissecting Gastric Ulcer: Review of the Literature and Report of a Case. Perry B. Hudson, Lendall C. Gay, and Howard E. Newman. *Arch. Surg.* 50: 301-303, June 1945.

Acquired gastrothoracic fistula resulting from peptic ulcer is a rare condition; the authors could only find 25 previous reports. Their case is one in which an acute type of ulcer burrowed through the gastric and esophageal walls, with perforation into the left thorax. The abdominal cavity remained unsoiled. Fluid removed by thoracentesis was proved to be gastric contents. No operation was undertaken, and the patient died about twenty-one hours after onset of acute symptoms; it was believed that no surgical procedure could have been effective. LEWIS G. JACOBS, M.D.

Duodenal Ulcer in a Large Army Camp: Incidence and Statistical Analysis. Horace B. Loder and Stanley A. Kornblum. *Mil. Surgeon* 96: 492-497, June 1945.

In a series of 1,702 patients with abdominal complaints at a large army camp, the history and symptoms warranted roentgen investigation of 394 (23.15 per cent). One in every 4 of those examined by x-ray had organic disease (95 patients) and one in every 5 (82 patients) had active duodenal ulcer. No gastric ulcers or perforated duodenal ulcers were found in this series. Gastric analyses were of no aid in differential diagnosis. There was no appreciable difference in the incidence of duodenal ulcer in the white and Negro soldier. Fifty-six (68.29 per cent) of the patients with duodenal ulcer had symptoms prior to going on active duty. Many of the soldiers with duodenal ulcer presented atypical and psychosomatic complaints.

Case of Trichobezoar. Gösta Gräberger. *Acta radiol.* 25: 504-506, Nov. 21, 1944. (In German.)

The author reports the case of a 4-year-old girl who had been addicted to eating her own hair for about a year. The presenting symptom was an epigastric mass the size of a fist. Roentgen examination of the stomach showed the presence of a typical bezoar; the pylorus remained constantly open during roentgenoscopy. At operation the bezoar was found to be of hair and to have a "tail" which extended through the length of the duodenum. LEWIS G. JACOBS, M.D.

Intussusception in Children: Spontaneous Reduction and the Sources of Error in Its Diagnosis. Hans Hellmer. *Acta radiol.* 25: 514-526, Nov. 21, 1944. (In German.)

In children not all cases of intussusception are diagnosed roentgenologically. In some instances the intussusception is so small that it does not lead to symptoms before spontaneous cure. Even if symptoms are present, cases may not be studied because of early operation or death. In some instances the barium enema reduces the condition so rapidly that the disease

is not observed by the roentgenoscopist. This is most often true of intussusceptions at the ileocecal valve. Other cases undergo spontaneous reduction before examination. In such instances the residual roentgen signs are not striking, consisting of an accentuated mucosal pattern, swelling of the ileocecal valve, or swelling (edema) of the ileal or cecal wall producing a filling defect. The importance of negative findings in the interval is that they indicate a better prognosis for non-recurrence.

Two illustrative cases are cited. In the first a chronic ileocecal intussusception, demonstrated roentgenologically, disappeared without treatment. In the second, the condition was reduced by the enema examination; the fluoroscopist, however, mistook barium in the sigmoid for terminal ileum and reached an erroneous diagnosis. LEWIS G. JACOBS, M.D.

On Strangulating Obstruction of the Small Bowel with Special Reference to Cases with Poor Roentgen Findings. J. Frimann-Dahl. *Acta radiol.* 25: 480-492, Nov. 21, 1944. (In English.)

Among 228 cases of mechanical ileus, with the obstruction situated within the abdominal cavity, 32 cases of true strangulation occurred. Twelve of the 32 cases showed scant or nearly negative roentgen findings. In all 12 cases a strangulation ileus was found and in most instances resection had to be done. The reasons for the lack of roentgen evidence of strangulation in nearly one-third of the cases are discussed. The cause is presumed to be a special mechanism with regard to the accumulation of intestinal gas. On the basis of these observations, the author recognizes two types of strangulating obstructions as seen roentgenologically. One, with clear gas and fluid levels, gives positive findings; in the other, with a lack of intestinal gas, the picture is practically negative.

Technic of Contrast Examination of the Sigmoid Colon. Lars Billing. *Acta radiol.* 25: 418-422, Nov. 21, 1944. (In German.)

The hazard of overlooking a lesion in the sigmoid on account of the overlapping of the loops can be avoided by pushing the sigmoid above the ileocecal line, which is accomplished by filling the bladder. Ingestion of large amounts of fluids several hours before examination is the method recommended. The recto-sigmoid junction is best studied by a film made with the central ray directed into the pelvic inlet, either by tilting the tube 35° or by raising the back from the table a corresponding amount. [While these two procedures appear to have a limited sphere of usefulness, the commonly employed technic of spot-film radiography under fluoroscopic control, especially in oblique projection, appears to have a greater useful field of application.—L. G. J.] LEWIS G. JACOBS, M.D.

Case of Fluoroscopically Reduced Sigmoid Volvulus. Bengt S. Holmgren. *Acta radiol.* 25: 564-568, 1944. (In German.)

The author reports two cases of sigmoid volvulus. His original technic of passing a gastric sound into the volvulus under fluoroscopic control failed in the first case, but successful reduction was obtained by passing a stomach tube into it under fluoroscopic control (with barium enema) and injecting fluid into the aboral segment of the sigmoid. LEWIS G. JACOBS, M.D.

Stenosis of the Sigmoid in the Newborn. W. R. Bagley and E. C. Bagley. *Minnesota Med.* 28: 455-457, June 1945.

After a rather general discussion of congenital atresia or stenosis of the bowel in the newborn, with statistics of its incidence in various parts of the intestinal tract, the author reports his own case, in which the stricture involved the first part of the sigmoid. Signs of obstruction appeared about forty-eight hours after birth, when the abdomen became distended and the infant began to vomit green-colored mucus. The diagnosis was made roentgenologically with the aid of a barium enema, the obstruction being localized in the sigmoid where it crosses the pelvic brim. Above this point the intestinal loops were greatly distended with gas. The stenosed loop of bowel was exteriorized at operation and a catheter placed below the bowel to secure the loop outside. Another catheter was placed in the bowel for decompression, the usual double-barreled colostomy being subsequently made. Three months later the continuity of the bowel was restored, and at eight months the child appeared entirely normal. The surgical problems arising in the handling of the tiny colon of an infant are described as they were successfully solved in this case.

PERCY J. DELANO, M.D.

Cases of Intermittent Colon Invagination on the Basis of Tumor. Gösta Lindquist. *Acta radiol.* 25: 641-648, Nov. 21, 1944. (In German.)

This report describes two cases. The first was a colocolic intussusception on the basis of a carcinoma of the sigmoid; the act of invagination was observed fluoroscopically. When invagination occurred, the patient experienced a sensation of blocking of the colon. In the second case a polyp of the sigmoid offered some diagnostic difficulty; eventually the diagnosis was made and the polyp removed.

LEWIS G. JACOBS, M.D.

Unusual Case of Pure Colon Invagination. Arne Clausen. *Acta radiol.* 25: 423-426, Nov. 21, 1944. (In German.)

The author reports a case of colocolic intussusception occurring in the sigmoid, apparently due to a band of adhesions. The patient recovered following operative reduction.

LEWIS G. JACOBS, M.D.

Megacolon in the Newborn. A Clinical and Roentgenological Study with Special Regard to the Pathogenesis (A Preliminary Report). Th. Ehrenpreis. *Acta paediat.* 32: 358-370, 1945. (In English.)

A clinical and roentgen study of the onset and course of megacolon in 9 newborn infants showed the underlying factor in this condition to be a disturbance in the emptying of the bowel. Roentgenographically megacolon, as a development secondary to such disturbance, is shown to occur within a varying period of time, which was established in 4 of the present series as from three weeks to three and a half months. One patient with intermittent symptoms had a normal colon picture at the age of one month; at three and a half months there was only a moderate dilatation of the sigmoid; and at the age of ten months, a colossal dilatation of the whole colon. Redundancy of the colon and of the sigmoid, in particular, was not more marked than in normal infants. No localized obstruction was detected.

This study does not support the malformation and obstruction theories for megacolon.

(a) Cases previously described as megacolon in the newborn and in infants are of too long standing to prove the congenital nature of the changes, or too uncertain to establish their megacolon nature. The abdominal distention soon after birth in infants with megacolon is a manifestation of a disease resembling ileus and does not prove the congenital dilatation of the colon.

(b) The significance attributed to colonic redundancy is based on insufficient knowledge of the normal anatomy of the colon in the newborn. The redundant colon at this stage is, no doubt, due chiefly to the fact that the space left to the colon is considerably reduced by the largeness of the liver and the smallness of the pelvis. The colon therefore takes a sinuous course, which must be considered as physiological with regard to this particular age.

Megacolon may thus be characterized as a dilatation and hypertrophy of the colon owing to disturbed evacuation of the bowels. The particular kind of disturbance and the possible existence of a neuro-anatomical substratum have not as yet been elucidated. For the time being, therefore, it is consistent with prevailing terminology to define this disturbance as a functional disorder.

Luetic Rectal Stricture. A. Melamed and S. M. Feld. *Am. J. Digest. Dis.* 12: 203-206 June 1945.

A case of syphilitic stricture of the rectum is reported by the authors, who believe it to be a rare condition. The patient, a white female aged 36, complained of diarrhea and postprandial colicky pains starting in the epigastrium and radiating to the lower abdomen. There was no history of nausea, vomiting, or melena. A barium enema revealed a smooth constriction of the rectum, measuring 4 inches in length. There was no evidence of ulceration. Blood Kahn tests were repeatedly positive (4+). Frei tests taken on two occasions were negative. Antisyphilitic therapy was given over a period of two years, during which time the area was checked by successive x-ray examinations. The plates shown with this article demonstrate a gradual decrease of the amount and extent of the stricture.

There are many causes of constriction of the rectum, the most common being gonorrheal proctitis. If this is suspected, a search for the Gram-negative diplococcus should be made. Lymphogranuloma inguinale will show a positive Frei test and will not improve under antisyphilitic treatment. It will also show evidence of mucosal destruction, sinuses, and fistulous tracts. Carcinoma usually occurs on the anterior wall of the rectum and a biopsy will give a positive diagnosis. Diverticulitis usually occurs at the junction of the descending and sigmoid colon; if there is an associated carcinoma in the same area, diagnosis may be difficult. The lesions of endometriosis are shown as sharply demarcated areas on x-ray examination.

JOSEPH T. DANZER, M.D.

Calcified Appendices Epiploicae as Freely Mobile Bodies in the Abdominal Cavity (A Roentgendiagnostics Interesting Subsidiary Find). Olallo Morales. *Acta radiol.* 25: 653-661, Nov. 21, 1944. (In English.)

A case of a freely mobile calcification, situated within the abdominal cavity, diagnosed roentgenologically and proved histologically to be a calcified appendix

epiploica, is presented. Six similar hitherto unverified cases were collected by the author from the records of the Roentgen Department of the Karolinska Institute; five of these showed calcifications with considerable mobility, while the sixth showed a calcification which could not be displaced but which lay outside the adjacent organs. The author considers it probable that the calcifications in these cases originated from appendices epiploicae detached from, or still adhering to, the colon.

THE LESSER PERITONEAL SAC

Radiological Findings in Lesser Sac Effusions. M. C. Morrison. *Canad. M. A. J.* 52: 474-477, May 1945.

Two unusual cases characterized by collections of fluid in the lesser peritoneal sac are reported. The first patient was a two-year-old girl who experienced a sudden attack of severe abdominal pain. The abdomen was distended, tense, and rigid, with no palpable mass. The white cell count was 22,500. Surgical exploration was considered inadvisable. Eight hours after onset, swelling and crackling of the soft tissues of the neck and upper chest were noted. Aspiration of the stomach contents produced only 15 c.c. of colorless fluid microscopically negative for blood. The temperature ranged between 99 and 100° F., and the pulse was fast and irregular.

X-ray examination of the abdomen, limited to the anteroposterior view with the patient in the supine position, revealed a circular area of finely stippled increased density in the left upper quadrant with downward displacement of the splenic flexure of the colon to the level of the iliac crest. There was a small pocket of air in the lower mediastinum and a triangular opacity in the region of the left leaf of the diaphragm, but the lung fields were otherwise clear and the heart normal. The spleen was not visualized but the left kidney was clearly outlined. The stomach air bubble was absent. The tentative diagnosis was volvulus of the stomach with collections of fluid and air in the lesser peritoneal sac or partial herniation of the stomach through the diaphragm. Radiographs made six hours later showed a decrease in the size of the cystic area with air extending from the mediastinum into the soft tissues of the neck, and at this time a rupture of an abdominal viscus was suggested.

Death occurred twenty-two hours after onset of the illness. Necropsy was done and the final diagnosis was strangulation and perforation of the stomach with extravasation of gastric content into the lesser peritoneal sac followed by pneumoperitoneum and mediastinal emphysema.

The second patient was a female 58 years of age who was operated on for chronic cholecystitis with cholelithiasis. The immediate postoperative course was uneventful, but after the patient's discharge colicky pain recurred, and two months later she suffered a severe chill with pain in the left shoulder and epigastric distress. There was dullness over the lower part of the left side of the chest, and aspiration in the ninth interspace posteriorly resulted in the removal of one liter of fluid resembling a thick bile. On readmission to the hospital, the patient appeared toxic, with rapid pulse but normal temperature and no dehydration or jaundice. The abdomen was tense, with a tender area of dullness in the hypochondrium, extending down to the umbilicus. The white cell count was 17,500. Stool and urine were negative for bile. The clinical impres-

sion was extravasation of bile into the lesser peritoneal sac, so confined by closure of the foramen of Winslow. Radiographic studies confirmed this impression and revealed a homogeneous opacity of fluid density in the lower part of the left lung field, elevation of the left leaf of the diaphragm, and a mass of increased density in the pancreatic area confluent with the liver shadow. The kidney outlines were apparently normal. The stomach, as outlined by barium, showed the upper border displaced downward and backward about 3 or 4 inches, apparently by extrinsic pressure. At operation, about 1 liter of brownish-yellow fluid was drained from the lesser peritoneal sac. There was no fluid in the greater peritoneal sac. The pathological diagnosis was hepatic degeneration, cholangitis, and bile peritonitis of the lesser sac. The patient had an uneventful recovery. X-ray examination three weeks later showed a marked reduction in the size of the mass indenting the stomach outline. The source of the bile in this case was probably leakage around the drainage tube in the cystic duct. The tension of the effusion was attributed to three factors; the ball-valve action at the foramen of Winslow, the exudation of serum from the cells of the sac due to irritation by the bile salts, and the bellows action of the diaphragm.

On the basis of these cases the author lists the roentgen signs of effusion in the lesser peritoneal sac. They are: (1) a direct shadow on the roentgenogram if the collection of fluid is large; (2) expansion of a pancreatic area causing a pressure deformity on the air- or barium-filled stomach, probably on the lesser curvature and posterior wall, in small effusions; (3) displacement of the stomach downward, to the left and posteriorly, in large effusions, evident on lateral and anteroposterior films; (4) preservation of the kidney outline; (5) increased pliability and compressibility of the gastric walls on fluoroscopic palpation; (6) chest findings similar to those in other subdiaphragmatic lesions—elevation of the diaphragm, chiefly the left leaf, with decreased respiratory movement and decreased radiability of the lower lung fields, possibly with a "strand shadow," probably from pleural transudate.

In the differential diagnosis, one must consider pseudocyst of the pancreas, true cyst of the pancreas, primary cyst of the omentum, subdiaphragmatic abscess, and retroperitoneal tumors. Cysts of the head of the pancreas enlarge the duodenal loop but cysts of the body and tail of the pancreas may simulate the described condition very closely. Primary cysts of the omentum are usually localized and movable. Subdiaphragmatic abscess is much more common on the right side. It often contains air and is usually associated with fever.

BERNARD S. KALAYJIAN, M.D.

THE SMALL PELVIS

On the Roentgen Diagnosis of Space-Restricting Processes in the Small Pelvis. Lennart Walldén. *Acta radiol.* 25: 856-873, Nov. 21, 1944. (In English.)

Cystography has been found of great assistance by the author in the diagnosis of space-restricting processes in the small pelvis which do not appear at all, or less distinctly, on an ordinary roentgenogram. It is especially useful in cases where exploration or palpation is difficult or impossible.

The technic as developed in the investigation of 40 such cases is described and illustrated by numerous roentgenograms. After voiding, the bladder is filled

with 200-250 c.c. of air, eventually supplemented by a rather small amount of contrast fluid. (Astrabaryt in a potassium permanganate solution was found to give the best results and is easily removed by rinsing the bladder.) Pictures are then taken in rapid succession in order to avoid the refilling of the bladder with urine. With the patient supine, frontal and lateral views are obtained, and following these, "pictures with vertical rays with the patient turned slightly to the right and left." Additional views may include a film with vertical rays with the patient in a half-sitting position and films with horizontal rays with the patient lying on his right and left sides. Films may also be taken with the intestines filled with a contrast medium.

The location, form, expansion, and displacability of space-restricting processes in the small pelvis can be determined in relation to the distended bladder and the adjacent contrast-filled intestines. In certain cases the topographical character of the formation, when taken in conjunction with the clinical data, offers the possibility of determining the approximate nature of the process.

THE MUSCULOSKELETAL SYSTEM

The Intervertebral Disc: Its Microscopic Anatomy and Pathology. Part I. Anatomy, Development, and Physiology. Part II. Changes in the Intervertebral Disc Concomitant with Age. Part III. Pathological Changes in the Intervertebral Disc. M. B. Coventry, R. K. Ghormley, and J. W. Kernolian. *J. Bone & Joint Surg.* 27: 105-112, 233-247, 460-474, January, April, July 1945.

This excellent series of articles considers the changes that take place in the intervertebral disk at the lumbosacral level, reporting the findings in a series of 88 cases, including both the roentgenologic and the pathologic features. The lumbosacral area was chosen because that region is the most frequent site of clinical complaints and because many congenital changes are found there.

The material for this study was obtained from routine necropsies. The disks with the body above and part of the sacrum were removed, fixed in formalin, x-rayed, decalcified, and stained. The sections were studied microscopically and by projecting the sections containing the whole disk on a screen.

The vertebral body is composed of cancellous bone with dense smooth bone plates on the superior and inferior surfaces. These plates are divided into three zones; the central, with numerous small holes; the peripheral, with larger and less numerous holes; and the epiphyseal ring, surrounding the outside of the plate. The disk is composed of a cartilaginous plate, covering the bone plate of the vertebra; the annulus fibrosus arising from the cartilaginous plate and surrounding the nucleus pulposus; and the nucleus pulposus, which is a semigelatinous material.

The vascular channels in the cartilaginous plates are present only in the first three decades of life. The epiphysis is found to be a complete bony ring about the vertebral body and is not absent posteriorly. The disk does not have a joint cavity.

In the second paper of the series the macroscopic and microscopic changes are minutely considered according to decades. The various components are described separately for each decade, with demonstration of degenerative changes in the latter part.

The third paper discusses the various pathologic changes. Hypertrophic arthritis is evident by the presence of osteophyte formation and is assumed to be due to bone formation along the Sharpey fibers that have been subjected to strain from the longitudinal ligaments.

Nuclear expansion begins after the fifteenth year. This is usually a normal variation but in extreme degree is considered pathological. Usually the cartilaginous plate is thin and defects may be present. The expansion is probably due to a high water content of the nucleus.

Ballooned disks are always found in the presence of decalcification of the vertebrae. The disks are in good condition, but there is a definite decrease in the number and width of the trabeculae of the bodies.

Where the disk is thinned, this is found to be due to (a) desiccation and necrosis of the nucleus or (b) rupture of the annulus or defective cartilaginous plate or both.

Intraspongy nuclear herniation occurs through a defect in the cartilaginous plate and is not evident on a roentgenogram until sclerosis of the surrounding bone occurs. The herniation probably does not cause pain, but symptoms may occur as the result of the hernia, with thinning of the disk, degenerative changes, and shifting of the axis of motion.

Anterior nuclear protrusions are rare but an example was found in this series. There is a break in the anterior longitudinal ligament. The hernia is composed of desiccated nuclear material with degeneration of the disk.

Posterior nuclear protrusion is quite common. It is the result of trauma, with rupture of the posterior longitudinal ligament and the posterior portion of the annulus and a loss of nuclear substance, followed by thinning of the disk.

The entire disk may become calcified or any portion may contain calcium deposits. Such calcification is easily recognized.

Invading infection of the disk is usually secondary, arising from adjacent vertebrae or along the ligaments or by way of the blood stream. In tuberculosis the disk may become involved early by spread along the longitudinal ligaments. In brucellosis the infection invades the disk before the vertebrae.

Malignant invasion of the disk rarely occurs. One specimen showed metastatic carcinoma of the vertebra with protrusion of the disk into the body but no disk destruction or invasion. JOHN B. McANENY, M.D.

Rôle of the X-Ray in the Diagnosis of Posterior Herniation of the Intervertebral Disc. Arthur E. Childe. *Canad. M. A. J.* 52: 458-470, May 1945.

The author gives an excellent survey of the history of myelography by different methods, showing the advantages and disadvantages of each. He prefers the use of pantopaque and believes that it is necessary to inject 5 to 6 c.c. if one is to find many of the smaller disk lesions which may easily be missed with smaller amounts. He gives a detailed description of the technique for injection of the material, only a few points of which can be mentioned here. After successful spinal puncture has been accomplished, a small amount (0.25 c.c.) of pantopaque should be injected and the patient observed fluoroscopically to be sure that the material is going into the subarachnoid space. If this droplet of oil is seen to move freely as the table is tilted, one can go

ahead with the injection of the remaining portion. It has been found that, even though spinal fluid drops freely from the needle, one may inject oil into the subdural rather than the subarachnoid space. After the injection has been completed, the needle is left *in situ* for later aspiration of the oil and is covered with sterile gauze strapped down to the patient. Careful fluoroscopic study of the oil and its movement up and down the spinal canal with tilting of the table is carried out. The patient is first studied in the prone position and later turned 35 to 40 degrees to one side and studied in the oblique position. The opposite oblique is also studied. The author does not feel that the lateral position is very helpful. Adequate spot films should be made throughout the examination to record the changes seen fluoroscopically.

After completing this part of the examination, the patient is returned to the prone position and the oil is pooled under the point of the needle by tilting the table under fluoroscopic guidance. The author goes into considerable detail regarding the aspiration of the oil and gives several helpful hints. He feels that with patience, careful manipulation of the patient, and a certain amount of ingenuity and experience, one should be able to aspirate almost all of the oil in the drainage sac. Since the original spinal puncture is usually made between L3 and L4 to avoid the most common sites for nucleus lesions lower down, it is sometimes practical to make a new spinal puncture at these lower levels for aspiration of the oil, if it cannot be withdrawn through the original puncture.

In examining the cervical portion of the spine, the author suggests the use of soleless leather boots laced about the patient's feet and ankles and attached to the end of the table by straps. With these in place, the patient is more easily handled and one can tilt the head downward almost to the vertical position if necessary. It is unnecessary to keep the oil in one mass as it passes over the thoracic hump, as it tends to agglomerate when it reaches the cervical region. Extension of the neck will prevent the oil from passing upward into the head.

The author believes that plain radiographic studies should be made on each case. He does not believe that these are very often diagnostic of nuclear herniation but may be suggestive. This is particularly true with narrowing of the disk space between L4 and L5 and localized hypertrophic bony changes. Mention is also made of unilateral sacralization of the transverse processes of the fifth lumbar as frequently associated with herniation of the disk between L4 and L5.

The illustrations in this article show the classical defects seen with the larger herniated nuclei and also some of the smaller changes which have been found by the author at operation to be due to disk herniations. He believes it is important to study very carefully the axillary pouches as outlined by the oil and to watch the column of oil as it passes up and down over the suspected area. Minute asymmetries of the axillary pouches or minute changes in the speed of passage of the oil over one side as compared with the other may indicate the presence of a nuclear herniation which would be missed in a less careful examination.

Multiple herniations are not uncommon. Usually only one of these produces symptoms. If myelography is not done preoperatively, only one area may be explored and the operation will be a comparative failure, since the other nuclei may later cause trouble. A warning is issued against attempting myelography

within a few days after a spinal puncture for diagnostic purposes, since many curious defects may be shown, which are misleading and result in erroneous conclusions, as proved by later studies.

Herniations of the intervertebral disks of the upper lumbar and thoracic vertebrae are far less common than those of the lower lumbar region. The author believes, however, that disk herniations are fairly common in the lower cervical region. The plain films of the cervical spine, particularly oblique views, may be very suggestive of the presence of herniated disk. Because of the width of the spinal canal at this level, it is very important that 5 to 6 c.c. of opaque oil be used. With smaller amounts, the layer of oil will be so thin that the appearance is somewhat deceiving. The technique for study of this region is very similar to that used in studying the lower parts of the spine. On completion of the examination, the oil is returned to the lower part of the spine for aspiration.

It has been found that weight-bearing may increase considerably the size of a given defect in the myelogram. The application of traction on the feet and shoulders may reduce the size of the defect. In a nervous, tense individual, the defect may appear larger than it does later when the patient becomes more relaxed. Flexion of the spine tends to decrease the size of the lesion and extension to increase it.

As to the differential diagnosis, hypertrophy of the ligamentum flavum produces a defect in the posterolateral portion of the subarachnoid space, whereas the herniated nucleus is in the anterolateral portion. A very swollen nerve root may produce a defect simulating that of a disk herniation. Tumors of the cord usually produce more sharply outlined defects or a complete block, and extradural tumors usually produce a block which is not opposite the intervertebral space.

BERNARD S. KALAYJIAN, M.D.

Instability Associated with Disk Degeneration in the Lumbar Spine. Folke Knutsson. *Acta radiol.* 25: 583-609, Nov. 21, 1944. (In English.)

In an attempt to produce a functional test of the stability of the disk junction, profile roentgen pictures of the lumbar spine were taken in a series of 149 cases with the patient in the upright position and bending as far backward and as far forward as possible. In normal cases parallel displacement does not take place between the vertebral bodies, and the tilting between the vertebrae is harmonious and similar throughout. When the disk is degenerated, there often appear signs of instability in the form of parallel displacement and abnormal tilting movements. In a large number of cases these signs of instability were the only manifestation of disk degeneration, the intervertebral space and surfaces of the vertebral bodies being intact. Thus the author's method often permits early diagnosis. In 71 of the 140 cases examined, the findings were negative, signifying that the vertebrae and intervertebral spaces were free of changes and that there was no instability. In 16 of the 69 cases with disk degeneration, two disks were affected and in 1 case three disks. Only one disk was involved in the remaining cases. The total number of degenerated disks was thus 87. In 58 of the number there were anatomic signs of degeneration. Eighteen of the disks were anatomically normal but showed instability. Spondylolisthesis was present in 11 patients.

Occurrence and Significance of Early Periosteal Proliferation in the Diaphyses of Premature Infants. Nils Malmberg. *Acta paediat.* 32: 626-633, 1945. (In English.)

This paper deals with 114 premature infants, 72 of whom had received prophylactic antirachitic therapy in the first week of life. Forty-two infants receiving no such treatment served as controls. The infants were reared for in a special ward and were reared for the most part on human milk, supplemented with small additions of Czerny's flour and butter gruel during the early part of the investigation and later with citric acid milk.

Roentgenograms were taken at varying intervals over a twelve-month period of the costochondral junctions, the bones of the forearm and leg, and in some cases the bones of the upper arm and thigh. The films revealed in a great many of the infants, both treated and untreated, a linear periosteal deposit of calcium of varying length along the diaphysis, usually on the tibia, but in some infants on the fibula, radius, femur, and humerus. It was generally observed at four to six weeks of age; in a few instances as early as three weeks, in a few not until eight to ten weeks, and in a few at twelve weeks. In some instances it was merely a fine, almost indistinguishable, line; in others it was somewhat thicker. In later films it was possible in some individuals to distinguish deposits arranged in layers. Within two to four weeks the deposit in its less severe form had in some instances fused with the bone and become wholly or almost indistinguishable. In cases where the deposit was thicker or in layers, it was visible for a long period of time in the form of a thickening of the corticalis. Sometimes the calcareous deposit was separated from the original cortex by a narrow rarefied zone resembling an extra marrow space. Films taken two to four weeks before the appearance of the calcium deposits in many of these cases showed that the corticalis was unclear and indistinctly outlined against the soft tissues at the site of the deposit which was later to appear; the surface seemed to be slightly fluffy and not sharply outlined, indicating that periosteal proliferation of what was probably osteoid tissue, which was later to become calcified, was in progress.

Twenty-seven of the 42 control infants showed early signs of periosteal reaction in the various bones; in 15 of these, rachitic changes appeared later. Ten of 29 infants receiving 2,700 international units of D₃ from and including the fourth to the sixth day of life, 14 of 29 infants receiving 10,000 international units from and including the fourth to the seventh day of life, and 3 of 14 infants receiving 500,000 international units of vitamin D₂ in two doses, on the fourth and seventh days of life, showed periosteal proliferation in the diaphyses. Only 6 of the treated cases later showed signs of rickets.

The author concludes that periosteal proliferation at the diaphysis of the long bones, especially of the tibia, is a sign of vitamin D deficiency and should be regarded as the earliest roentgen evidence of rickets, often appearing four to six weeks before the epiphyseal change.

Etiology of Osteochondrosis Dissecans. S. Ribbing. *Acta radiol.* 25: 732-755, Nov. 21, 1944. (In German.)

On the basis of statistical and pathological studies, the author advances the theory that osteochondritis dissecans results from detachment of a superficial accessory nucleus of bone (found in the femur in childhood), which is considered to remain relatively isolated from surrounding bone because of persisting

bands of epiphyseal cartilage, and therefore to be unusually prone to loss of circulation from minor traumata, even those due to normal function. This explains the fact that the articular cartilage as such remains intact.

LEWIS G. JACOBS, M.D.

Albright's Syndrome (Polyostotic Fibrous Dysplasia with Cutaneous Pigmentation in Both Sexes and Gonadal Dysfunction in Females). Malcolm B. Dockerty, Ralph K. Ghormley, Roger L. J. Kennedy, and David G. Pugh. *Arch. Int. Med.* 75: 357-375, June 1945.

Six new cases of Albright's syndrome, encountered at the Mayo Clinic, are reported, bringing the total number of cases recorded in the literature to 39. Roentgenograms from one case are reproduced. A comprehensive discussion of the roentgenologic characteristics and pathological features of this condition is included. Two of the authors' observations are contrary to the general impression obtained from the literature. One is that extraskeletal manifestations may occur in the absence of extensive osseous lesions; the other that clinically silent but roentgenologically extensive and active lesions of bone can be present in adults who have Albright's disease.

Bone Sarcoma in Polyostotic Fibrous Dysplasia. Bradley L. Coley and Fred W. Stewart. *Ann. Surg.* 121: 872-881, June 1945.

The authors report two cases of bone sarcoma arising on the basis of fibrous dysplasia. In both instances the patients reported to the hospital because of pain and a tumor, and in both cases an identical histologic pattern, consisting of non-bone-forming pleomorphic spindle- and giant-cell sarcoma, was observed. Both tumors appeared radiographically to have produced metastases, while the relief of pain subsequent to small doses of radiation was remarkable.

ELLWOOD W. GODFREY, M.D.

Different Types of Osteo-Arthritis in the Hip Joint and Their Connection with the Anatomical Conditions. Does There Exist Any Subluxation Coxae Acquisita? Ivan Hermodsson. *Acta radiol.* 25: 527-550, Nov. 21, 1944. (In English.)

Roentgen signs of osteoarthritis of the hip point to a definite connection with the anatomy of the joint.

The CE angle as described by Wiberg (*Acta chir. Scandinav. Supp.* 58, 1939) is used to distinguish between the normal joint and one not normally developed. C denotes the center of the femoral head, E the lateral edge of the acetabular roof. The sides of the CE angle are formed by the line between C and E and by a line drawn through C in the longitudinal axis of the body. CE angles below 20 degrees may be considered definitely pathologic and indicate a defective development of the acetabular roof, while values over 25 degrees are definitely normal. Values between 20 and 25 degrees are uncertain. Large CE angles are more common in males and small CE angles in females.

In a series of 170 joints showing signs of osteoarthritis the author found a definite connection between the localization of cartilage destruction and structural changes. With CE angles of less than 20 degrees, the destruction was localized solely or mainly in the upper part of the joint. With angles of 20 to 25 degrees the cartilage changes were also largely in the upper part, though the medial part was sometimes in-

volved. In the normally built hip joint (*CE* angle over 25 degrees), two types of osteoarthritis were distinguished. Type 1 shows destruction of cartilage mainly in the medial part of the joint, type 2 in the upper part. Osteoarthritis of type 2 has several interesting characteristics, above all a double floor. The author believes that osteoarthritis of type 1 is an expression of primary arthrosis deformans and type 2 a real chronic arthritis. So-called subluxatio coxae acquisita (Morville: *Acta orthop. Scandinav.* 4: 133, 1933; 7: 107, 1936) is only an example of osteoarthritis of type 2.

Subcostal Swelling of the Soft Tissues in Osteochondritis. Knut Lindblom. *Acta radiol.* 25: 610-613, Nov. 21, 1944. (In English.)

Roentgenography has been found by the author to be of aid in the diagnosis of osteochondritis of the anterior ends of the ribs. With one exception, in 20 cases of osteochondritis tangential films showed a local swelling of the soft tissues on the inner side of the cartilage or at the junction between the cartilage and the bone. The swelling varied in thickness in different patients from 2 mm. to 2.5 cm. In most instances, it was situated at the level of the second rib; in the other cases it was seen in the region between the third and sixth ribs. Calcium deposits were present in two instances; but it was difficult to distinguish these from the normal calcifications of cartilage.

In the one case in which the roentgenogram was negative and operation revealed chondritis, there was a fistula leading to the sternal insertion of the second rib, and the absence of pathologic changes in the film was ascribed to the fact that the abscess must have drained through the fistula. In this patient, contrast filling along the fistula gave a local diagnosis.

Tangential films of the cartilage in 16 anatomic specimens from normal patients showed no swelling of the soft tissues such as was observed in the patients with osteochondritis.

Case of Chondrodystrophia Congenita Calcificans. Sigvard Jorup. *Acta radiol.* 25: 580-586, Nov. 21, 1944. (In German.)

The author reports the case of a child with chondrodystrophia congenita calcificans, under observation from shortly after birth to the age of fourteen months. The condition is characterized by small, sharply defined areas of calcification in the bones preformed in cartilage, giving a characteristic picture. The bones may be small, and deformities are usually asymmetrical. The condition is probably related to classical chondrodystrophy; its occurrence is about 1 in 500,000 births. While prognosis is for progressive deformity, cases have not been followed for more than two years. A table of reported cases is included.

LEWIS G. JACOBS, M.D.

Case of Hurler's Disease (Lipochondrodystrophy). H. R. Sear and J. K. Maddox. *M. J. Australia* 1: 488-492, May 12, 1945.

The authors are here dealing with a clinical entity which is as yet fairly new to the literature. It exists in several forms, all variants of one parent condition. This condition is as yet not too perfectly understood, with the result that many confusing classifications are appearing, some in textbooks which are considered authoritative and, indeed, are so in many respects.

The authors quote from "A Textbook of Radiology" by British authors: "Gargoylism appears to be an allied disease, in that bone changes identical with chondro-osteo-dystrophy are encountered. It was first described by Hurler, and is referred to as chondro-osteo-dystrophy of the Hurler type, but the name 'gargoylism', which is more commonly used, well describes the large head and grotesque facies of the children affected." From this they "beg to differ," taking the firm position that the disease is a lipochondrodystrophy.

It would not seem proper to let this statement go unchallenged. A thorough review of the literature—and the description by Brailsford (not cited by the present writers) is the first to follow the original description by Gertrud Hurler, though it was written ten years later (*Am. J. Surg.* 7: 404, September 1929)—reveals no particular stress on the lipid element in the dystrophy. As Brailsford approaches the subject, it represents a dystrophy in the transformation of cartilage into bone; splenomegaly and hepatomegaly may or may not be present; corneal opacities may or may not occur.

The authors present a case history. The condition they are doubtless describing is the one described by Gertrud Hurler in 1919, and by Brailsford in 1929. Morquio also described the condition in 1929, and his name has come to be attached to one type of the bone disease. All of the synonyms refer to one basic entity: it is known as Hurler's syndrome, osteochondrodystrophy, Morquio's disease, gargoylism, lipochondrodystrophy, and dysostosis multiplex. In 1941 Dr. Maximilian Hubeny and the abstractor made a rather complete study of a case, our report being one of the early ones in the American literature (*Am. J. Roentgenol.* 46: 336, September 1941). At that time we had to orient ourselves, from a rather confusing and poorly co-ordinated group of case reports, in the matter of terminology. Going back to the basic articles, reviewing the reported cases and examining their roentgenograms, we chose the term dysostosis multiplex which seemed then coming into favor, but later regretted that we did not cling to the name "Hurler's syndrome," since credit is due to Gertrud Hurler for the first comprehensive description of this entity.

Attempts to use the above-mentioned synonyms to designate separate disease entities is a step backward rather than forward and tends to create confusion. Even Caffey in his excellent textbook on Pediatric X-Ray Diagnosis has been ensnared by the confusing terminology, and separates different types of one entity into distinct entities.

There is one cardinal diagnostic point which should be sought in dealing with any of the various types of Hurler's syndrome. The lateral view of the lumbar spine will usually exhibit—and rather early, too—a characteristic *beak-like deformity*: the lower anterior margin of the vertebral body projects forward; this is for the reason that ossification in the upper portion of the vertebral body is deficient. The appearance is so striking that, once seen, it will never be forgotten and never be confused with any other vertebral deformity. It is usually apparent at the first examination; if it is not found, or only suggested, a few more examinations at short intervals will usually suffice to demonstrate it most convincingly. Credit for stressing the characteristic vertebral deformity goes to Brailsford of England.

PERCY J. DELANO, M.D.

Identical Twins: Achondroplastic Dwarfs. S. J. Woodman. Ohio State M. J. 41: 521, June 1945.
The author records briefly the delivery of twin achondroplastic dwarfs, who died shortly after birth. The mother was apparently in good health and roentgen studies showed no abnormalities of her pelvis or long bones. Two previous pregnancies had been normal. There was no history of any unusual illnesses in the family of either father or mother. Roentgenograms of the infants are reproduced.

GYNECOLOGY AND OBSTETRICS

Value of Hysterosalpingography in Diagnosis of Gynecological Affections. Origene Dufresne. Urol. & Gyn. Rev. 49: 345-350, June 1945.
The author describes his technic for hysterosalpingography with lipiodol. The patient is given tincture of Iodonna, 20 drops, one hour before the examination. The genitalia are prepared and the oil (usually about 1 cc.) is injected with moderate pressure. Its progress is observed fluoroscopically, and films are taken as desired (65 kv., 80 ma., 1-2 seconds, with Lysholm grid). Such examination supplements other methods of gynecological study and furnishes valuable information, thus preventing unnecessary surgical procedures. It is indicated in metrorrhagia, sterility, genital pain, developmental anomalies of the internal genitalia, pelvic tumors, ectopic pregnancy, and for postoperative observation following surgery of the tubes. It is contraindicated in the presence of acute infection, profuse bleeding, and possible pregnancy, and immediately following a menstrual period.
The author outlines the findings in the normal genital tract and in various pathological conditions.

MAURICE D. SACHS, M.D.

Radiology of Pelvic Types and Their Obstetrical Significance. D. G. Maitland. M. J. Australia 1: 537-539, May 26, 1945.

It is noteworthy that in the opening section of this paper the author admits that he has not felt adequate confidence in the Ball method of pelvcephalometry, inasmuch as "a volumetric method based entirely on the volume capacity of two pelvic diameters—namely, the conjugate diameter and the bischial diameter—could lead to errors in judgment of the true pelvic capacity, if the important factor of pelvic type was not considered at the same time." Thus, cesarean section might be done in a patient with a narrow bischial diameter, though the pelvis was otherwise adequate.

With regard to pelvic types, the author follows the classification of Swenson and Molloy: gynecoid, android, platypelloid, and anthropoid. He points out that pelvic shape is important from the standpoint of deep transverse arrest and deep posterior arrest of the fetal head. Transverse arrest is associated with the flattened posterior segment of the gynecoid, platypelloid, and android types; the arrested posterior position is associated with the anthropoid type.

In the flat type of pelvis, critical attention must be paid to possible cephalopelvic disproportion. In the android pelvis, there is an interference with anterior rotation: deep transverse arrest and a persistent posterior position are therefore to be kept in mind. The anthropoid pelvis may not be too formidable if there is no outlet contracture.

PERCY J. DELANO, M.D.

Pelvic X-Ray Measurements and Pelvic Contraction. Eric W. Frecker. M. J. Australia 1: 532-537, May 26, 1945.

In the beginning, the essayist stresses certain "postulates," which, he points out, apply not only to the roentgenology of obstetrics, but to the field of roentgenology as a whole: first, that adequate cognizance should be taken of the clinical findings and the clinical picture; second, that there is no such thing as an "x-ray diagnosis," but the diagnosis is to be arrived at by a careful consideration of all the ascertainable facts concerning a patient; third, that we are dependent, as radiologists, upon the clinician, and should obtain from him not only facts pertaining to the patient's particular problem, but also pertaining to the specialty he represents, the better to fortify our interpretations of shadows seen in films; fourth, that clinical knowledge in any field is necessary to prepare us for new radiologic advances, as in radiologic obstetrics and radiologic neurology; fifth, that we must strive to acquaint the various specialties with the possibilities and limitations of the roentgen ray in diagnostic work, that they may consult us for such aid as we are able to render, and not expect of us that which we cannot perform.

The essayist employs the pelvic type classification of Swenson and Molloy: gynecoid, android, anthropoid, and platypelloid. For pelvic mensuration, the Thoms method is preferred; though for pelvic cavity and outlet measurements, the Ball method is employed. A film is taken routinely in Chassard and Lapine's position (patient leaning forward while seated over the cassette, so that the pubic arch lies parallel and close to the film). The type of pubic arch is viewed with regard to its relation to a possible outlet contracture.

The Ball method for the pelvic interior has been found better than the "stereoscopic pointer" method. Both the Ball and Thoms methods have been found accurate, in inlet measurements, within 0.5 cm.

PERCY J. DELANO, M.D.

THE GENITO-URINARY TRACT

Roentgen Examination of the Urinary Tract with Special Reference to Methods of Examination and Findings in Individuals with Testicular Tumors. Joseph C. Bell, Gilbert W. Heublein, and Howard J. Hammer. Am. J. Roentgenol. 53: 527-562, June 1945.

The technical aspects of the roentgen examination of the urinary tract are discussed and the roentgen signs in some of the diseases affecting it, especially testicular tumors, are described.

For intravenous urography, the proper selection of patients is important. Sensitivity to the contrast medium should be determined. Patients are prepared with castor oil or compound licorice powder given the evening prior to the examination. Food and fluid are withheld after midnight, and a cleansing enema is given one hour before the examination. The roentgen examination begins routinely, with a preliminary roentgenogram of the entire urinary tract; another film is made five minutes after the injection is completed and is developed immediately. Pressure is then applied over the sacral promontory by a compression band and balloon and maintained for five minutes, following which stereoscopic roentgenograms are made of the upper part of the tract. Pressure is then released, and an exposure of the entire tract is made immediately. If normal excretion is occurring on both sides, a roent-

To attain the necessary objectives of non-radical surgery for hydrocephrosis, the symptoms must be relieved, the obstruction permanently removed, infection eliminated, and renal function conserved and restored. The postoperative evaluation of surgical results is extremely important. A successful result must be confirmed by urography after a reasonable postoperative period in order to avoid false impressions of cure.

Five basic operative techniques are listed by the author for the surgical management of ureteropelvic obstruction. One case of congenital obstruction of the right ureteropelvic junction with high insertion of the ureter in a three-year-old child is mentioned, with clinical course and follow-up confirmatory urographic study.

JOHN H. FREED, M.D.

TECHNIC

Military Photoroentgen Technique Employing Optimum Kilovolt (Peak) Principles. Arthur W. Fuchs. *m. J. Roentgenol.* 53: 587-596, June 1945.

The optimum kilovoltage theory of technic is based upon the premise that for every roentgenographic projection, there is an optimum kilovoltage that will fully penetrate a given part with the production of a minimum of secondary radiation fog. The extensive use of photoroentgen examination by the Armed Forces brought to light a number of faults in commonly used techniques. These included use of too low kilovoltages, too high milliamperages, and inadequate development or failure to use time-temperature development. In order to eliminate the variable factors as much as possible, increase roentgen-ray tube life, and improve the diagnostic quality of the photoroentgenograms, the optimum kilovoltage technic was applied. The use of this technic depends upon the classification of all body parts into three groups, small, average and large, for the purpose of facilitating the use of time factors in convenient multiples, and upon a standardized processing procedure.

For photoroentgenography, a generator capable of

delivering 100 kv.p. at 200 ma. should be employed. A synchronous timer capable of timing in tenths of seconds is necessary. The constant factors include a kilovoltage of 100, milliamperage of 150, distance of 36 inches, and use of a stationary grid. The time is varied according to the size of the patient, 0.2 sec. for small (17-24 cm. chest thickness), 0.3 sec. for average (25-27 cm.) and 0.3 sec. for large (27-32 cm.). For chest thicknesses above 32 cm., 14 × 17-inch films are used.

The use of such a high kilovoltage provides a long-scale contrast, so that all detail is visible, yet the density is never excessive; the abundant secondary radiation produced is controlled by the stationary grid. The long axis of the roentgen tube should be vertical, with the cathode end uppermost. In this position the greatest quantity of roentgen rays is directed toward the upper thorax, where the greatest tissue density usually exists. The rate of operation should be one stereoscopic pair per minute. In processing, a standardized time-temperature method is essential. Photoroentgen film requires eight minutes development at a temperature of 68° F. in fresh Kodak developer. Lack of adequate development was a major factor in the poor results obtained earlier.

L. W. PAUL, M.D.

Wet-Film X-Ray Viewing Room. Leo H. Garland and Milo T. Harris. *U. S. Nav. M. Bull.* 44: 1288-1291, June 1945.

The authors show plans for construction of a wet-film viewing room which had been found useful under conditions which do not permit extending the wash-water tank through the wall of the dark room. The viewing room is between 4 and 6 feet square and is provided with film illuminators, preferably wall-mounted. A light-proof pass tunnel below the level of the loading bench carries a wooden frame holding 6 films (14 × 17-in.). The frame slides on two wooden rails and is pulled manually from one room to the other. The light-tight lids of the pass tunnel are guarded by a simple sliding metal bar on top, so that when one lid is opened the other cannot be raised.

RADIOTHERAPY

NEOPLASTIC DISEASE

Adenofibrosis Mammæ. The Norwegian Radium Hospital's Material 1932-1942. Rolf Bull Engelstad and Rolf Weyde. *Acta radiol.* 25: 444-459, Nov. 21, 1944. (In English.)

During the ten-year period, 1932 through 1941, 142 patients, 3 men and 139 women, were treated at the Norwegian Radium Hospital for adenofibrosis mammæ. Palpable alterations in the breasts, particularly in the upper outer quadrant, were found in 136 patients. In 54 cases, pain was the outstanding symptom, and in 2, the only symptom. A tumor was accidentally discovered by 54 patients and was the only symptom in 28. Tumor and spontaneous pains occurred together in 84 patients. Thirty-two patients had enlarged axillary nodes.

One hundred and twenty-three of the patients with adenofibrosis mammæ were treated by roentgen rays. The mamma was irradiated tangentially from both sides, two fields on each breast. The field varied in size, usually being from 15 to 20 cm. in length. The

technical factors were 180 kv., 4 ma., F.S.D. 50 cm., with a filtration of 0.5 mm. Cu. Each field was given a series of five treatments of 150-200 r, so that each breast received a total of 1,500-2,000 r in the course of ten to twenty days. Seventy-four of the 123 patients were symptom-free at the time of the report; 16 were relieved of pain but still had palpable mammary thickening; 6 were improved, with pain and palpable thickening; 27 were unchanged. Seventeen patients were subsequently operated upon.

Seven women bore children after the conclusion of the treatment. There was little or no milk secretion in 4 of these patients; lactation was abundant in 1, and in the other 2 cases no information is available.

On Improving the Results of Treatment in Cancer of the Collum of the Uterus. J. Heyman. *Acta radiol.* 25: 551-563, Nov. 21, 1944. (In English.)

Heyman discusses a paper by Hultberg (*Abst. in Radiology* 45: 643, 1945) which recommends hysterectomy on a larger scale in irradiated cases of cancer of the cervix, with a view to preventing local recur-

rences. Hultberg considers hysterectomy advisable because of the great number of local recurrences following irradiation, the presence of vital cancer tissue in specimens removed after radiotherapy, the results already obtained by the proposed intervention, and finally the impossibility of curing a local recurrence by repeating the intracavitary application of radium. Heyman is of the opinion that statements as to the percentage of local recurrences are unreliable and the presence of vital cancer tissue in specimens removed after irradiation of little importance. He believes that the number of patients lost at routine hysterectomy will probably exceed those saved by the operation. Results following radiotherapy in cervical cancer at the Radiumhemmet are submitted. These show that the five-year cure rate during the past seven years has increased considerably. Heyman believes that attempts to prevent local recurrences by improving the radiotherapeutic technic promise more than routine hysterectomy following irradiation.

Wilms' Tumors. Archie L. Dean. New York State J. Med. 45: 1213-1217, June 1, 1945.

Various aspects of Wilms' tumors are discussed, using as a basis the reports of other workers in addition to experience with 80 cases seen at Memorial Hospital (New York).

In infancy Wilms' tumors are second in frequency only to tumors of the eye. They are congenital, embryonal, mixed tumors, arising from the kidney anlage. The average age of patients when the tumor has been discovered is about three years. The stage of embryonal development at which the tumors arise is of great clinical importance because this factor modifies the structure of the growth, its natural history, and to a considerable degree its response to different types of treatment.

Wilms' tumors grow rapidly and tend to metastasize fairly early, both by lymphatic extension and by way of the blood stream. Symptoms usually do not appear until late. If growth of the tumor is sufficient there may be vomiting, loss of weight, asthenia, anorexia, and the appearance on the abdomen of tortuous, dilated, superficial veins. Accidental discovery of a mass in the abdomen was the first finding in 64 per cent of the 80 cases seen at Memorial Hospital; pain in the loin or abdomen in 16 per cent; asthenia and malaise in 12 per cent; hematuria in 4 per cent; frequency of urination in 4 per cent. Fever is frequently present.

Discovery of a palpable tumor in the kidney region is the most important diagnostic sign and its presence in a young child should lead to a tentative diagnosis of Wilms' tumor. Other less frequent abdominal masses to be considered in differential diagnosis are lymphosarcoma or other tumors of the retroperitoneal or mesenteric lymph nodes, suprarenal tumors, tuberculosis of the kidneys, hydronephrosis, polycystic kidneys, tuberculous peritonitis, hepatic tumors, ovarian tumors, splenomegaly, pancreatic tumors, fecal tumors, and psoas abscess. Intravenous and retrograde urography and kidney function studies are recommended. Under no circumstances should the tumor be incised to obtain material for microscopic study, since this destroys the capsule and encourages rapid and widespread growth.

There is no clear-cut unqualified answer to the question, "What is the best treatment for Wilms'

tumor?". Cure depends on removal or complete destruction of the neoplasm before metastasis occurs. Ladd's five-year survival rate of about 50 per cent in a series of cases treated by surgical removal alone (Ann. Surg. 108: 885, 1938) has not been approached by other surgeons. Of 20 patients treated at Memorial Hospital by irradiation alone, 5 are living, without evidence of disease, five or more years after treatment. The author does not, however, advocate this procedure. In cases without demonstrable metastases he recommends preoperative x-ray treatment, 100 r to one of three portals daily. Usually in about two weeks the mass is no longer palpable. The kidney is then promptly removed, with clamping and ligation of the renal pedicle before the tumor is disturbed. If any extension of the tumor is seen, postoperative irradiation is given, 100 r daily to one of four portals covering the side of the abdomen from which the tumor was removed. In cases with demonstrable metastases, irradiation alone is recommended for its palliative effect.

H. H. WRIGHT, M.D.

Multiple Carcinomas. A Case of Four Consecutive Primary Carcinomas with Apparent Cure. C. A. Highland. J. A. M. A. 128: 356-359, June 2, 1945.

A case in which four metachronous primary carcinomas (adenocarcinoma of the right breast, squamous-cell carcinoma of the esophagus, basal-cell carcinoma of the left cheek, adenocarcinoma of the colon) occurred in the same person within a period of ten years is reported. Two of the lesions were treated by radical surgery and two by roentgen therapy, apparently with complete cure.

This is one of the first recorded cases of carcinoma of the esophagus with five-year cure following roentgen irradiation. Irradiation was administered (see communication, J. A. M. A. 128: 1046, Aug. 4, 1945) over a thirty-eight day period in daily (occasionally the interval was forty-eight or seventy-two hours instead of twenty-four hours) doses of 100 r, to a total dose of 3,000 r, to each of four skin portals, anterior, posterior, and right and left oblique lateral. This heavy dosage was well tolerated, with a minimum of skin reaction and discomfort. Follow-up roentgenograms have shown the esophagus to be apparently normal.

Roentgen Treatment and the Course of Cure of Giant Cell Tumor in the Osseous System (10-12 Years' Cure). Gösta Jansson. Acta radiol. 25: 569-579, Nov. 21, 1944. (In English.)

Four cases of giant-cell tumor of the osseous system which were treated by roentgen irradiation only, followed by ten to twelve years' cure, are recorded. The dosage which should be used in the treatment of such tumors is discussed. Pre- and post-treatment roentgenograms are reproduced.

Research with Radioactive Isotopes in the Treatment of Leukemia. Erik Lindgren. Acta radiol. 25: 614-624, Nov. 21, 1944. (In German.)

The radioactive elements used in the research here described were sodium chloride containing ^{24}Na (half life, 15 hours) and Na_2HPO_4 containing ^{32}P (half life, just over 14 days). The radioactive sodium emits very hard gamma rays, while the phosphorus emits beta particles. It had been demonstrated that in normal

and leukemic experimental animals, radioactive phosphorus tends to localize in the lymph nodes, spleen, and liver. It should be possible, therefore, to use this element to give selective bombardment with beta particles to leukemic tissues. Similar selective absorption of ^{32}P by other neoplasms has also been demonstrated. The use of radioactive sodium was not based on metabolic selectivity, but on the idea of general body radiation.

This report is based on 4 cases of myeloid leukemia, of lymphatic leukemia, and 1 of polycythemia vera. Initially the radioactive salts were given intravenously and retention and excretion checked with a Geiger-Müller counter. The increased count was found to last as long as four but not five days after each injection. Later the phosphate solutions were administered by mouth in various media, of which glucose solution proved the best. The dose was 1.2 mc. in a week, later reduced to 0.8 mc. Patients showed a rather poor response to radioactive sodium, but the response to radioactive phosphorus was much better. Only palliation was obtained in all cases. Anemia did not occur as a result of this treatment, nor were there any side actions.

LEWIS G. JACOBS, M.D.

NON-NEOPLASTIC DISEASE

Roentgen Therapy for Acute Encephalitis. U. V. Kortmann and Roger Lough. *Am. J. Roentgenol.* 53: 97-102, June 1945.

The results of roentgen therapy in 49 cases of acute encephalitis are reported. The average skin dose was 5 to 100 r to each side of the head, including the base of the skull, given daily or on alternate days, usually for a total of 300 r or less. Usual 200-kv. technical factors were employed. Of the 49 patients, 29 recovered, 15 were improved, 1 died, and in 4 there was no follow-up. Best results were obtained when roentgen therapy was given before degenerative changes were established in the central nervous system. Relief of symptoms and signs was dramatic in many patients, improvement beginning within two to three days.

L. W. PAUL, M.D.

Roentgen-Ray Treatment of Tinea Capitis. Lester M. J. Freedman and Lawrence G. Beinhauer. *Urol. & Cutan. Rev.* 49: 376-378, June 1945.

In a period of one year (1944-45), 53 patients with tinea capitis were treated with roentgen therapy: 41 males and 12 females, ranging in age from two to twelve years. Each patient was examined under filtered ultraviolet rays.

The basic principles of the Kienböck-Adamson technique were employed: that is, 5 circular fields 5 inches in diameter were used, centered over the vertex, frontal, occipital, and both supramastoid areas. The port centers of the neighboring fields were exactly 5 inches apart, and the central rays of adjacent portals were directed at right angles to each other. All areas were treated at one sitting, the factors being 100 kv.p., 10 ma., 25 cm. distance. Approximately 380 r per field was given. Epilation was uniform, beginning in seventeen to twenty-four days. It was complete in about a week in 47 cases. Incomplete epilation was obtained in 5 patients and in one there was no epilation. Regrowth of hair took place within ten to twelve weeks. Seven patients complained of headaches and nausea

eight to twelve hours after therapy, but these symptoms rapidly disappeared. There was also some pruritus, and furunculosis and occipital adenitis occurred as a result of scratching.

MAURICE D. SACHS, M.D.

TECHNIC

Experiences with Roentgen Rotation Therapy. Lars Edling. *Acta radiol.* 25: 427-443, Nov. 21, 1944. (In English.)

The apparatus for roentgen rotation therapy at the Gutavus V Jubilee Clinic in Lund is described, together with a discussion of the main principles of rotation therapy. A short report of the technical details of treatment, the dosage employed, and results obtained is included. A comprehensive bibliography on roentgen therapy with a movable beam is appended.

Condenser Ionization Chambers for Measurement of X-Rays in Body Cavities: Physical Problems in Their Design. F. T. Farmer. *Brit. J. Radiol.* 18: 148-152, May 1945.

The construction of a small condenser ionization chamber is described. It is suitable for insertion into body cavities so that the depth dose can be measured directly. It has a capacity of 200 r with suitable accuracy for measurement during treatment.

SYDNEY J. HAWLEY, M.D.

A New Circuit with Special Applications in Gamma-Ray and X-Ray Dosimetry. L. A. W. Kemp. *Brit. J. Radiol.* 18: 107-112, April 1945.

A simple circuit by which two ionization currents may be compared is described. This was designed primarily for measuring radon seed strengths, and its use for this purpose is described in detail. It may be used for measuring x-ray beams also. It can be calibrated to read directly in r.

SYDNEY J. HAWLEY, M.D.

Defects in Roentgen Tubes Demonstrated by Gamma-Ray Photographs. Sven Benner. *Acta radiol.* 25: 414-417, Nov. 21, 1944. (In German.)

In a number of x-ray therapy tubes the output decreased for no apparent reason. Attempts to radiograph the target with x-rays (165 kv.) were unsuccessful because of diffuse fog, but gamma-ray photographs of satisfactory quality were obtained by using a 50-mg. radium tube with 0.35 mm. gold and 0.30 mm. platinum filtration. At a radium-film distance of 70 cm. an exposure of four to five hours was required with intensifying screens, or about thirty hours without screens. These films showed that the tungsten button had worked loose from the copper stem in several instances.

LEWIS G. JACOBS, M.D.

A Technique for Auto-Radiographs of Radium Containers. Dorothy F. Clephan. *Brit. J. Radiol.* 18: 117-120, April 1945.

A method is described for checking the distribution of radium in tubes and other containers, by autoradiography. The radium containers are placed on a tray made of clear film in which have been cut grooves to keep the needle or tube from rolling or sliding. Identification of the container may be made by placing lead numbers and letters beside it on the tray. The tray is

then placed in contact with an x-ray film. A flash exposure is made with ordinary light to outline the container and its label, and the container is then allowed to make its own exposure on the film. A formula is given for determining the exposure. All radium containers should be examined in this manner every five to ten years. SYDNEY J. HAWLEY, M.D.

EFFECTS OF RADIATION

Implications from Studies with Physical Carcinogens. Paul S. Henshaw. *J. Nat. Cancer Inst.* 5: 419-436, June 1945.

The practical effects and the theoretic effects which produce a state from which cancer is generated are set forth in this article. The paper "(1) brings together pertinent information derived from studies with physical carcinogens; (2) considers the broad implications arising therefrom; (3) seeks to correlate the findings of similar results obtained with other carcinogens; (4) examines this body of evidence in the light of various ideas of cancer; and (5) sets forth the writer's view of carcinogenesis at this time."

The more significant physical carcinogens are listed as mechanical irritation, heat, sunlight, ultraviolet light, and ionizing radiations. Under this last heading the author considers radiocarcinoma, radiosarcoma, and radioleukemia.

Radiocarcinoma was of more frequent occurrence in the early days of roentgen therapy, when the ef-

fects of irradiation with x-rays were not appreciated. Radiosarcoma is well illustrated by the radium watch dial cases, in which the ingestion of radium was followed by the occurrence of bone sarcoma (Marshall: *Am. J. Cancer* 15: 2435, 1931). Radioleukemia is believed to have a higher incidence among radiologists than any other group. The role of radiation in leukemia has also been shown experimentally, an incidence of 3.5 per 1,000 being observed in irradiated mice as compared with 0.6 per 1,000 in non-irradiated mice (Krebs, Rask-Nielsen, and Wagner: *Acta radiol. Supp.* 10, 1930).

The combined action of physical and chemical carcinogens has been found to be the quickest and surest way to produce skin cancer in animals.

The remainder of the article gets away from the recording of findings in the literature and discusses current theories on carcinogenesis under the following headings: (1) findings with carcinogens other than physical; (2) similarity of embryonic differentiation and carcinogenesis; (3) views regarding the underlying cancer process; (4) cancer as a form of differentiation; (5) general views, under which heading the author puts forth his views on carcinogenesis and nicely integrates the time-honored triad of (a) something coming into the cell from outside, (b) changes in certain of the inherent constitutional elements of the cell, (c) a process of development.

This article clearly shows long association with a subject to which no solution is apparent at the present time. S. F. THOMAS, M.D.

EXPERIMENTAL STUDIES

Mechanism of Shock from Burns and Trauma Traced with Radosodium. Charles L. Fox, Jr., and Albert S. Keston. *Surg., Gynec. & Obst.* 80: 561-567, June 1945.

In studies of shock, emphasis has recently shifted from the plasma proteins and other colloids to the electrolytes. Clinical studies in shock caused by extensive thermal burns have demonstrated the therapeutic efficacy of large doses of sodium salts in isotonic solution and led to the discovery of an unexpectedly large sodium retention. These studies suggested that redistribution of sodium was possibly a fundamental derangement in shock and prompted experimental studies with radosodium.

Two types of experiments were conducted in mice subjected to standardized shock from burns and trauma. In one type the animals were given radosodium in isotonic sodium chloride. Shock was produced twenty hours later, and the concentration of radosodium in the tissues and organs was determined. In a second type of experiment shock was produced first, and the animals were then treated with radosodium in isotonic saline. Twenty hours later, upon recovery from potentially fatal shock, the radosodium content was determined in tissues and organs.

The sodium content of injured skin and muscle was found to be greatly increased and to exceed the gain in water (edema). This indicated that additional sodium accumulated in the intracellular compartment.

As a result of redistribution of sodium and water, approximately one-half the total amount of extracellular sodium was side-tracked and rendered unavailable.

Administration of this amount of sodium by injection of 0.9 per cent sodium chloride containing radosodium was followed by nearly complete retention of sodium in the injured mice but by excretion of sodium in normal animals. The hypothesis that loss of plasma protein at the site of injury is the most important factor in the production of shock appears to be incorrect. The volume of circulating plasma is believed to be largely dependent upon the volume of extracellular fluid and its concentration of sodium. The side-tracking of sodium in injured tissue thus causes a reduction in plasma volume. C. R. PERRYMAN, M.D.

Resistance to Tumour Grafts Produced by a Cell-Free Tumour Extract. S. Russ and G. M. Scott. *Brit. J. Radiol.* 18: 173-175, June 1945.

A cell-free extract of Jensen's rat sarcoma was obtained by squeezing the tumor. When this fluid was injected into other animals, which were subsequently inoculated with small tumor grafts of the same type, various results ensued, depending upon the state of the tumor from which the extract was obtained. If the tumor from which the extract was expressed was rapidly growing, the growth of tumors in the recipient animal was stimulated. If the extract was from a tumor regressing either spontaneously or as the result of irradiation, regression occurred in the tumors in the recipient. Many of the animals receiving this type of extract were totally immune to the sarcoma. If the extract was from an irradiated tumor which had begun to shrink, no effect, either stimulation or inhibition, was seen. SYDNEY J. HAWLEY, M.D.

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The Value of Orchiectomy in the Treatment of Carcinoma of the Male Breast¹

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EXPERIMENTAL advance of the last decade resulted in the not unexpected discovery that sexual hormones play an important role in the causation of rather large groups of cancer. It was established from the earliest days of cancer investigation that one-third of all cancers occurring in the female and almost one-tenth of cancers occurring in the male originated either in the primary or secondary generative organs, but a documentary scientific explanation for this could not be furnished until recently.

The progress of research has been somewhat more swift, as is readily understandable, in the field of animal cancer and, therefore, a brief consideration of the more salient conclusions may not appear out of place.

Rhoads (1), in the Caldwell Lecture of 1942 before the American Roentgen Ray Society, reviewed in a comprehensive manner the wealth of experiments on the relationship of the sex hormones and certain types of cancer of the genitalia, as cancer of the breast of both sexes, cancer of the prostate, etc. In connection with cancer of the female breast in mice, he found evidence available pointing to the fact that in certain pure strains two factors are important in the causation of the neoplasm:

the hereditary factor, which is transmitted by the maternal parent, and a second factor, which is contained in the milk. If high-cancer strain offspring are foster-nursed on low-cancer strain mothers within twenty-four hours after birth, cancer of the breast develops rarely, whereas if low-cancer strain offspring are foster-nursed on high-cancer mothers, the cancer incidence rises from zero or thereabouts to 15 per cent. From this evidence, Rhoads deduced that, in the presence of both the hereditary and milk factors, the secretion of the ovary by rhythmically releasing estrogenic substances into the blood stream is directly responsible for producing cancer of the breast. The anterior lobe of the pituitary gland also plays a certain role by controlling the secretion of the ovary. As a further step, Murray transplanted ovarian tissue into castrated male mice of a strain in which the females possess a high incidence of breast cancer and thus he was able to produce experimental cancer of the male breast in a similar manner.

The theory of estrogenic causation of breast cancer in mice received additional support when, as a result of numerous and varied investigations, it was noted that the administration of ovarian secretion elicits in both sexes diffuse epithelial stimulation

¹ Read before the Joint Meeting of the American Roentgen Ray Society and the Radiological Society of North America, Chicago, Ill., Sept. 24-29, 1944.

of the mammary gland which, after passing through successive stages of metaplasia, leads to malignant neoplasia. In most instances, because of the slowness of the process, on histopathologic analysis various stages of metaplasia are encountered at the same time until at one more critical point the change culminates in cancer. If this focus is removed, the next most advanced point undergoes a similar evolution, and so on until the process becomes regional or general. In the presence of an already existing mammary carcinoma, the administration of ovarian secretion makes the disease much worse. Contrariwise, the suppression of the ovarian secretion in certain well outlined experimental situations tends to forestall the development of breast cancer or, if one is already present, to slow down its progress.

If we accept the estrogenic origin of mammary carcinoma in the human being, it is reasonable to expect that some of the observations made in animal experiments should hold for both men and women. Especially the suppression of the function of sexual hormones should offer a fertile terrain of clinical applicability. Unfortunately, the problem is not so simple as it would seem *a priori*. In mammary carcinoma in the female, surgical or roentgen castration has been applied periodically for nearly half a century, and the conclusions as to its value are still far from definite. A recent review of the subject (2) permits the following rather vague deductions: (1) In the presence of osseous metastases, roentgen castration is beneficial in one-third of the cases of mammary carcinoma, producing symptomatic relief and perhaps some prolongation of life. (2) In local recurrences and generalized visceral metastases, roentgen castration is of no particular value, although sporadic favorable results are described in the literature. (3) In the operable group of mammary carcinomas, routine roentgen castration is considered a futile effort, having no influence on the final results. More recently, considerable benefit is being claimed from surgical castration (bilateral oophorec-

tomy) in the premenopausal stage, but the number of cases published is still too small to warrant final conclusions.

In mammary carcinoma in the male, castration, which is best accomplished by bilateral orchiectomy, is of recent origin. Furthermore, because of the rarity of breast cancer in the male as compared to the female, only a few cases are described in the literature. It is not surprising, therefore, that here, too, the conclusions as to the value of the procedure should be indefinite. Farrow and Woodard (3), in January 1942, published their experience in 3 female cases and 2 male cases of mammary carcinoma with bone metastases. All 3 female patients received male hormones with unsatisfactory results. Of the male patients, one likewise received male hormone (testosterone propionate), and in the other a bilateral orchiectomy was performed. In the first patient, the osseous metastases continued to spread, pathologic fractures developed, and death ensued in ten months. In the second patient, regression of the tumor and of the osseous metastases, with complete relief of pain, occurred in four months after operation. Roentgenograms of the skeleton revealed no further spread, and the formerly destroyed areas showed increased calcification, indicating healing of the lesion. The decrease of the estrogenic excretion as well as a stable 17-ketosteroid output following the orchiectomy were likewise striking features. Rhoads (1), referring to this work, states that when male hormone (testosterone) or female hormone (estradiol) was administered to the 3 female and 1 of the male patients, the treatment was promptly followed by a striking rise of the serum calcium with a rise of serum phosphatase and an increased output of calcium in the urine. This indicates that the sex steroids stimulated enormously the rate of growth of carcinoma metastases in the bone, driving calcium out of the bone and producing increased bone destruction. In the other male patient, in whom the orchiectomy removed at least one source of the sterolic

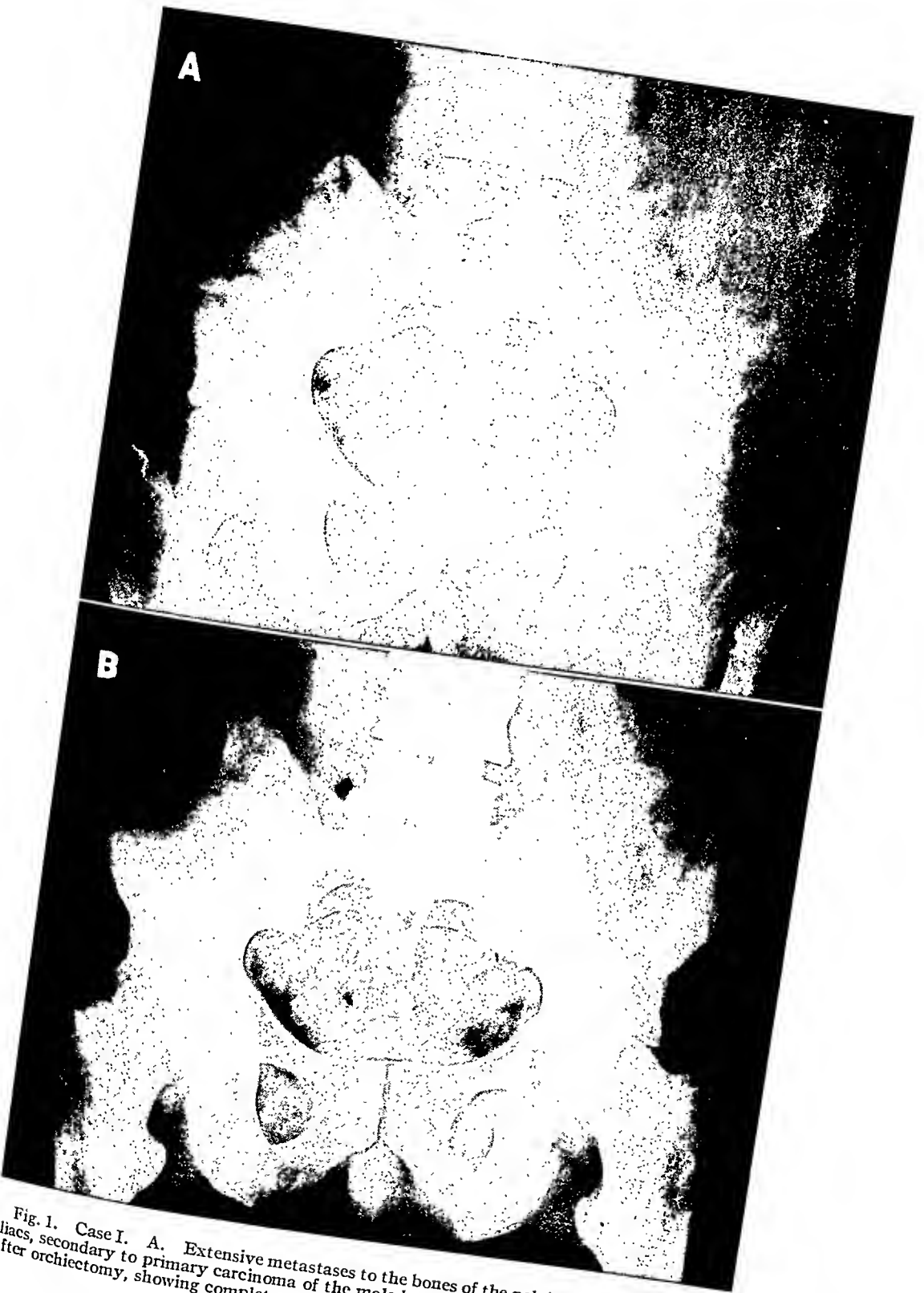


Fig. 1. Case I. A. Extensive metastases to the bones of the pelvic girdle, especially the iliacs, secondary to primary carcinoma of the male breast. B. The same patient one year after orchiectomy, showing complete reossification.



Fig. 2. Case I. A. Extensive metastases to the entire spine. B. The same case one year after orchiectomy, showing normal appearance of the spine.

hormone, exactly the reverse effect occurred.

Because of the paucity of material in the literature, it appeared worth while to present two additional cases of cancer of the male breast in which orchiectomy has been performed, since these may help to throw further light on the subject.

CASE I: J. C., male, age 68, noticed, in the fall of 1933, a small flat growth under the right nipple. On Sept. 24, 1934, a radical amputation of the right breast was performed. The microscopic report was advanced scirrhous carcinoma of the breast with involvement of the axillary lymph nodes. The wound healed rather slowly. From December 1934 to April 1935, three series of deep roentgen therapy were given with 200 kv., 1 mm. Cu. The entire right anterior thoracic wall, axilla, supraclavicular and infraclavicular fossae were included, and doses of 110, 100, and 90 per cent SUD were administered in the successive series.² Repeated periodical check-up

examinations from April 1935 to June 1937 remained negative for evidence of recurrence or metastases.

On June 28, 1937, the patient returned with a recurrent nodule in the axilla near the anterior fold. This nodule was about 2 cm. in diameter. It was excised immediately under local anesthesia. The microscopic report at this time was cylindrical-cell carcinoma. From June 30, 1937, to Dec. 30, 1937, the patient received three additional series of deep roentgen therapy. The procedure was identical with that used formerly. Further periodic check-up examinations continued to give negative results until the summer of 1942. At that time the patient began to experience severe pain in the back and lost weight rapidly. Roentgenographic study on Oct. 10, 1942, revealed widespread osseous metastases (Figs. 1 and 2), but there was no evidence of local recurrence or visceral metastases.

On Oct. 31, 1942, a bilateral orchiectomy was performed. The microscopic study of the testes showed fibrous atrophy. The patient made an excellent recovery. Within four months, he regained his normal weight and became completely symptom-free so that he was able to return to work. Check-up roentgenograms made Sept. 17, 1943, revealed disappearance of the osseous metastases with good reossification of the formerly destroyed areas (Figs. 1 and 2). At the present, the patient is well and apparently free of carcinoma.

² One hundred per cent SUD represents 900 r (525 r in air) given in one seance on a field 20 × 20 cm. with an intensity of 20 r/min., if the quality of the roentgen rays is that obtained with 200 kv. equiv. (1 mm. Cu); and 1,100 r (800 r in air) if the quality is that obtained with 500 kv. equiv. (7 mm. Cu).

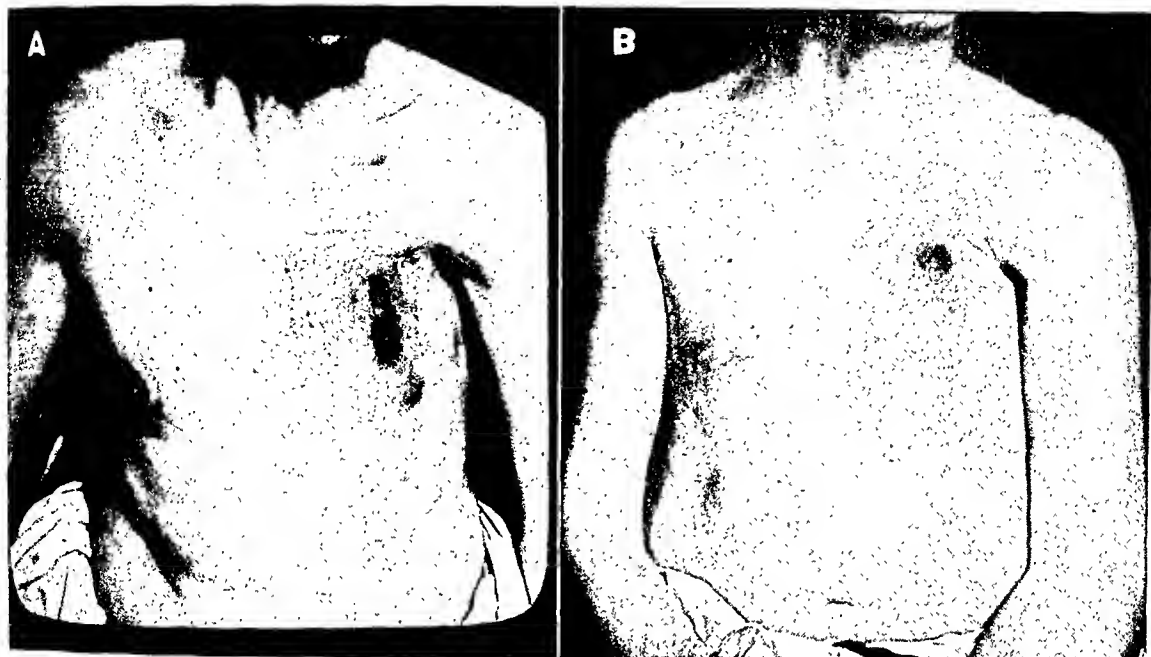


Fig. 3. Case II. A. Recurrent cancer en cuirasse in a case of a primary carcinoma of the male breast. B. The same case four months after orchiectomy, showing definite improvement. Following this, generalized metastasis developed, with death about four months later.

CASE II: W. F. K., male, age 67, noticed progressive enlargement of the left breast in November 1942. At the end of December 1942, a local mastectomy was performed. The microscopic study revealed a highly malignant medullary carcinoma with many hyperchromatic giant cells. On Jan. 11, 1943, the patient was referred for radiation therapy, to be followed by radical mastectomy in six to eight weeks. From Jan. 15 to Jan. 19, a full series of deep roentgen therapy was given with 200 kv., 1 mm. Cu. Attention was directed to the entire left anterior thorax, axilla, supraclavicular, infraclavicular, and cervical regions. A dose of 110 per cent SUD was given. On March 15, 1943, a radical mastectomy was performed. The microscopic analysis at that time showed nothing to reveal the nature of the original process.

From March 22 to August 26, 1943, the patient received 3 additional series of deep roentgen therapy with large doses, the technic of procedure being identical with that of the first series. On Jan. 10, 1944, he returned with a recurrence in the site of the mid-scar, giving the appearance of cancer en cuirasse (Fig. 3). There was also evidence of beginning metastases in the liver. The patient was losing weight rapidly.

On Jan. 24, 1944, a bilateral orchiectomy was performed. For four months there was definite improvement, with a gain of 20 lb. in weight and regression of the cancer (Fig. 3). In May 1944, the local recurrence again became active, and generalized visceral metastases rapidly developed. On August 23, 1944, the patient died.

DISCUSSION

Although two cases are insufficient to permit any definite conclusions, individually they can well be placed in similar groups observed in female breast cancer, where our knowledge is more complete. In the first case; after a period of about nine years, during which the primary growth and the regional lymph node metastases were completely brought under control by a combination of radical surgery and intensive radiation therapy, widespread metastases developed in the skeleton. Bilateral orchiectomy was performed in October 1942, merely as a last gesture in a hopeless situation. Within a few months there was a dramatic response. The severe pain completely disappeared and the patient regained his normal health. Roentgenograms revealed disappearance of the osseous metastases and showed compact reossification within the areas formerly destroyed. At present, nearly two years later, the patient is in good condition and the carcinoma still appears well controlled. This behavior, although unusual for such extensive carcinomas of the male breast, is

encountered not altogether infrequently in osseous metastases of the female breast following roentgen castration associated with other methods of treatment. Experience with a large number of cases at Harper Hospital shows that a symptom-free survival of three to four years, if no other vital viscera are involved, is common, and that individual patients have lived as long as ten years, although marked generalization of the osseous metastases existed from the beginning.

In the presence of local recurrences or visceral metastases of mammary carcinoma, the results were not as satisfactory. In the second case, the progress of the carcinoma as a whole was much more rapid than in the first, indicating a considerably higher malignancy index. Within a short time following radical surgery and very intensive irradiation, local recurrence developed in the form of cancer en cuirasse and there was evidence of beginning distant visceral metastases but no involvement of the osseous system. Here, too, following orchiectomy there was a definite initial response, with great improvement generally and a 20 lb. weight gain. The local recurrence regressed to about half its original size. Soon, however, the metastases in the viscera, especially the liver, got out of control, and the patient died nearly eight months later. Thus, the response to castration in this case conformed very much to that observed in similar instances of female breast cancer.

The reason why osseous metastases from mammary carcinoma of both sexes respond more readily than local recurrences or visceral metastases to the castration treatment, particularly in appropriate association with other methods of therapy, is not clear. It is possible that a neoplasm which, despite everything, produces local recurrence or swiftly invades distant viscera represents a cancer of extremely great activity from the beginning and that thus the removal of the estrogen source would have little or no influence on it. On the other hand, metastases to the osseous system are known to occur at a some-

what later period (in the first case nearly ten years after the onset of the carcinoma), suggesting a slower rate of growth of the cancer. Moreover, the osseous system itself does not possess a function as vital for the survival of the body as, for example, the liver, brain, and most other viscera, a fact which, in the end, results in an apparently additional prolongation of life. This view is supported by the long clinical experience in connection with breast cancer in the female. Despite some very spectacular initial results, a reactivation of the osseous metastases occurs sooner or later, and there is not a single case on record in which castration has produced a permanent control of the secondary bone lesions in carcinoma of the female breast. The good result in our first case of carcinoma of the male breast is only of about two years' duration, so that observation must be continued for several years before a final conclusion can be drawn.

Perhaps one should also mention the fact that recent experiments by Woolley, Fekete, and Little (4) have demonstrated that the removal of the gonads in either the male or the female mouse was followed by changes characteristic of feminization. That the stimulation was female-like rather than male-like after castration was evidenced by the lack of development of the accessory sex glands and the growth of the mammary glands. A nodular hyperplasia of the adrenal cortex was observed regularly and it is probable, therefore, that this became the source of the feminizing influence, especially since the adrenal changes have always preceded feminization. This observation is interesting, since it may help to explain why the administration of a male hormone (testosterone propionate) produces aggravation of the osseous metastases in mammary cancer of both sexes, as described by Farrow and Woodard (3), and why castration has the opposite effect.

SUMMARY AND CONCLUSIONS

Two cases of carcinoma of the male breast are presented in which, at a very

advanced stage, orchiectomy was performed as a therapeutic measure.

In the first case, the onset of the carcinoma dated back to 1933. Radical mastectomy and repeated series of deep roentgen therapy led to a satisfactory result until the summer of 1942, when general osseous metastases developed. In October 1942, a bilateral orchiectomy was done. Within a few weeks, there was a spectacular improvement, and the metastases completely disappeared in a period of a few months. At the present time, nearly two years later, the patient is in good condition and apparently free of carcinoma.

In the second case, the onset of the carcinoma was in the late fall of 1942. A radical mastectomy followed by four series of deep roentgen therapy failed to prevent the development of local recurrence, which assumed the character of cancer en cuirasse. There were also signs of beginning metastases in the liver but there was no invasion of the osseous system. In January 1944, a bilateral orchiectomy was done. Here, too, there was a very remarkable improvement, with a 20 lb. weight gain within a few months after the operation. In June 1944, however, extensive local recurrence developed, as well as widespread visceral metastases and at the end of August 1944, the patient expired.

The two cases are interesting since they

prove that osseous metastases can be brought under control by castration in mammary cancer of the male, whereas local recurrences and visceral metastases are influenced little or not at all. This observation conforms with the experience gained in mammary cancer of the female in a larger number of cases and over a longer period of time.

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DISCUSSION

Frederick W. O'Brien, M.D. (Boston, Mass.): I think we recognize that the effects of castration, whether chemical or surgical, whether in the male or female, are equivocal, and that in control of cancer and its metastases, some other factor or factors than control of hormonal secretion must be discovered and fitted into the picture puzzle before our results can be accurately predicted.



The Problem of Secondary Infection

in Carcinoma of the Cervix¹

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FEBRILE REACTIONS are a familiar feature of the clinical course in cases of carcinoma of the cervix. They are due to the bacterial infection associated with the tumor and not to the absorption of toxic products from the neoplasm. The virulence of existing organisms may be enhanced by treatment and give rise to alarming septic states that terminate fatally in a small number of the cases. The proportion of deaths occurring immediately, however, gives a misleading idea of the true influence of infection on the management of the disease and on the outlook for the patients who manifest pyrexia of lesser gravity. The present study was undertaken to determine the incidence and severity of infection in a series of cases treated at the Charity Hospital of Louisiana at New Orleans, in an attempt to assess the effect on the immediate and late end-results of treatment.

Much work has been done on the bacterial flora of the cervical tumor. In Laborde's clinic, aerobic streptococci and staphylococci were demonstrated in over 90 per cent of the cases examined, while streptococci were found in more than half of the anaerobic cultures and *Cl. perfringens* in more than one-fourth. Anaerobic streptococci were the organisms most frequently isolated by Von Haam and Connell in an unpublished study conducted at the Charity Hospital Tumor Clinic in 1934. Brunner found that anaerobic cultures were needed in some instances to detect the presence of virulent organisms, but doubted that the hemolytic streptococcus found in anaerobic culture is always pathogenic. Van Damme, who recovered streptococci either in pure or mixed culture in 74 per

cent of his cases, also pointed out that the hemolyzing property is not correlated with the virulence, which he believes is dependent on host resistance. The importance of the streptococcus is emphasized by the work of the German gynecological clinics, where striking differences in the operative mortality have been observed, depending on the presence or the absence of the organism. Heimann found that the parametria were almost regularly infected with bacteria in ulcerating cases of cervical cancer and not infrequently in non-ulcerating cases. Of 65 cases in which the parametrium was cultured, 36 showed streptococci; he feels that this is responsible for postoperative peritonitis. Ducuing has shown that pus from pelvic abscesses contains the same bacteria that could be cultured from the cervix. For these reasons Regaud feels that bacteriological examinations should be done in every case and that no treatment should be undertaken if streptococci can be demonstrated. Hurdon is not impressed with this need. At Charity Hospital the procedure is not performed routinely.

The material for the present analysis consists of 449 previously untreated cases of carcinoma of the cervix seen at Charity Hospital in the three-year period ending March 31, 1941. All cases with adequate histologic proof are included, even though untreated, to permit the estimation of absolute rates. Attention is restricted to the inflammatory complications of the disease at the time of the initial attempt to control it, or appearing as immediate sequels. Late manifestations incident to recurrence or secondary to radiation injuries will not be considered.

¹ From the Department of Radiology of the Charity Hospital of Louisiana at New Orleans, and the Tulane University of Louisiana School of Medicine. Presented at the Joint Meeting of the American Roentgen Ray Society and the Radiological Society of North America, Chicago, Ill., Sept. 24-29, 1944.

TABLE I: INFECTIOUS COMPLICATIONS OF CARCINOMA OF THE CERVIX

Pelvic cellulitis.....	87 (19.4%)
Pelvic peritonitis.....	20 (4.5%)
Urinary infection.....	14 (3.1%)
Pyometrium.....	11 (2.7%)
Diffuse peritonitis.....	4 (0.9%)
Pelvic abscess.....	3 (0.7%)
Thrombophlebitis.....	2 (0.4%)
TOTAL.....	141 (31%)

It is impossible to set up rigid criteria for a sharp classification of the cases into infected and uninfected. Some patients showed sporadic elevations of temperature to 101° or more but *tolerated treatment without untoward incident*. Others had fever definitely unrelated to the tumor (transfusion reaction, abscess of the buttock, erysipelas of the groin, bronchiectasis, lobar pneumonia, rheumatic carditis, etc.). Obviously all such cases had to be placed in the uninfected group. On the other hand, we have included in the infected class 141 patients who had repeated elevations of temperature to 101° or more, in most instances with a rapid sedimentation time or leukocytosis, or both, attributable to bacterial infection in the cervical tumor or lesions secondary to it.

Thirty-one per cent of our cases, therefore, showed febrile reactions of consequence. This apparently is not an unduly high percentage. While the incidence of fever in carcinoma of the cervix has been variously estimated as 10 to 78 per cent, the figure we observed approaches the rate most frequently given when the milder elevations of temperature are disregarded. Ducuing found that 46 per cent of 1,200 patients had rectal temperatures above 38° C. during treatment. Using a similar criterion, Goldscheider reported pyrexia in 37.5 per cent of 909 cases treated at the Marie Curie Hospital in London, and cited figures in the same range from other centers.

Serious morbidity from infection shows wider discrepancies. Bowing and Fricke reported only 3.6 per cent, Kessler and Schmidt 10.5 per cent, Ducuing 26.4. At Charity Hospital our figure is 31 per cent. In general the complications observed are as shown in Table I. Since more than one

complication may occur in a patient, either jointly or successively, the cases are grouped only under the most important one.

The largest group, pelvic cellulitis, includes a variety of clinical states difficult to discriminate and ranging in severity between cervical suppuration and frank pelvic peritonitis. Some subside spontaneously, but occasionally chronic sepsis and death result. Fatalities occur more often from the less frequent types of infection listed. Among these, peritonitis takes first rank. Septicemia, so seriously incriminated in the French literature, could be established (terminally) in only one case with urinary infection.

The hospital mortality rates observed in our series appear in Table II and are

TABLE II: PRIMARY MORTALITY IN 449 CASES OF CARCINOMA OF THE CERVIX

	Infected	Uninfected	Total
No. of cases.....	141	308	449
Hospital deaths....	13	6	19
Hospital mortality.	9.2%	2.0%	4.2%
Radium cases.....	72	218	290
Radium deaths....	3	1	4
Radium mortality.	4.2%	0.5%	1.4%

higher than the figures usually given in this country (1 to 2 per cent) as the treatment mortality from radiotherapy in carcinoma of the cervix. The explanation is probably evident in the table. We accept many terminal cases that in other localities would find their way to homes for the incurable. Some of these patients receive little or no treatment but are retained in the hospital during their brief period of survival since they have nowhere else to go. On the other hand, the patients with a better prospect of recovery receive radium therapy and exhibit mortality rates correspondingly lower. In any event, the patients with infection have a much graver immediate prognosis, their mortality rate being four to eight times higher than for the patients free from fever. In our radium cases the discrepancy almost exactly duplicates the figures given by Goldscheider—4.3 per cent mortality among 341 pyrexial cases, 0.3 per cent in 568 afebrile patients.

The unfavorable influence of infection is even more clearly shown in necropsy studies. According to Pearson, sepsis, principally peritonitis, is the cause of death in 23 per cent of the cases; only uremia (33 per cent) exceeds this proportion. It follows that, next to renal failure, sepsis is the most important lethal factor. Pearson and one of us subsequently collected an autopsy series of 74 cases of carcinoma of the cervix from the records of Charity Hospital for the period 1930-41. The inflammatory lesions found are listed in Table III and show

TABLE III: INFLAMMATORY LESIONS IN 74 AUTOPSIES FOR CARCINOMA OF THE CERVIX

Peritonitis.....	12 (16%)
Pyometrium.....	8 (11%)
Pyelonephritis.....	11 (15%)
Pyonephrosis.....	6 (8%)
TOTAL.....	37 (50%)

incidence rates practically identical with the figures obtained by Pearson in his earlier study. It is apparent that a grave inflammatory lesion is present either in the urinary tract, the peritoneum, or the genital organs in one-half of the cases examined postmortem.

It seems worth while to stress that, whatever the influence of treatment may be, more than 40 per cent of the complications encountered in this series, from the mildest to the gravest, occurred before any treatment was instituted, as can be seen in Table IV.

TABLE IV: ONSET OF INFECTIOUS COMPLICATIONS IN CARCINOMA OF THE CERVIX

Before treatment.....	58 (12.9%)
During x-ray therapy.....	27 (6.0%)
During radium therapy.....	49 (10.9%)
Post radium.....	7 (1.5%)

All the tabulated urinary complications were present prior to the administration of radiation. They form an integral part of the evolution of the neoplasm, since the essential factor in the development of infection is urinary stasis resulting from ureteral obstruction due to tumor infiltration of the parametria. The lesions in the urinary tract included pyelitis, pyelonephritis, and pyonephrosis, proved by cystoscopy, pyelography, and urinalysis. The respon-

TABLE V: INFECTION MORBIDITY IN 449 CASES OF CARCINOMA OF THE CERVIX

	No. of Cases	Incidence of Infection
All cases.....	449	31%
White.....	151	28%
Colored.....	298	33%
Stage I.....	35	20%
Stage II.....	132	32%
Stage III.....	219	30%
Stage IV.....	63	41%

sible organism was cultured in only two cases: *Escherichia coli* in one instance, *Staphylococcus aureus* in the other, the latter producing death by septicemia. An illustrative case history is appended (Case 1), typifying the fulminating character of some of these infections. Radium therapy was possible in two patients. They have remained well to date, but the median survival period for the group is only two months.

Pyometra was discovered on admission or following x-ray therapy in 9 cases and following radium therapy in 4. The total incidence, 2.9 per cent, is nearly equal to the figure given by Maliphant, 3.08 per cent, and by Healy and Frazell, 3.08 per cent. This is, however, considerably less than in the experience of European clinics. Hurdon, for instance, reported an incidence of 11.4 per cent. Uterine retroversion and cervical obstruction by tumor or by radiation changes have been held responsible for this complication. Six of our 9 patients with pyometra prior to radium therapy tolerated the treatment well; this is the rule, but occasionally the infection spreads and the possibility of controlling the neoplasm is lost. An example of this problem appears below (Case 2). The median survival period for the group was twenty-one months.

In an effort to determine the factors that might predispose to the development of infectious complications, we have recorded in Table V the morbidity in certain subgroups of the series. Contrary to clinical impression, we find that the incidence of infection is *not* significantly higher in the colored race. The table suggests that the more advanced lesions are infected more frequently, although the incidence gradient

is not so sharp as in the reports of Goldscheider and others. Van Damme believes the clinical extent of the carcinoma does not parallel the degree of infection, and Brunner has shown that the number and virulence of the organisms have little or no relation to the stage of the disease. It is most probable that while febrile reactions are more frequent in the advanced stages, fatal infection can occur in early lesions. Ducuing pointed out that fungating tumors are more likely to be infected.

The age distribution in the infected and uninfected groups is shown in Figure 1. It is clearly indicated that the infected patients are concentrated in the younger age groups. Colored women are known to develop carcinoma of the cervix at an earlier age, their average age in our series being four years less than the average age for the white patients. However, their presence in the series does not account for the downward shift in the distribution, since analysis of the white patients shows that those with infection are six years younger on the average than those without febrile reactions. This is in agreement with Laborde's observation that women less than forty are especially prone to have streptococcal infection. Ducuing, also, pointed out that young women are more susceptible to infection. The mean age for our infected group is 43.9 ± 11.6 years, while the mean age for the uninfected group is 49.8 ± 11.5 years. Testing the difference in the means by Student's distribution, $t = 5.01$, $P < 0.1$ per cent. We are justified in concluding that the average age is significantly lower in infected cases or, conversely, that sepsis occurs frequently in younger women from a true predisposition and not haphazardly.

Case 3, recorded below, is an example of severe pelvic cellulitis developing as a consequence of the repeated vaginal packing required to arrest severe bleeding. We had 8 such cases, with a median survival period of three months. Severe hemorrhage must therefore be considered a predisposing factor, although, of course, the packing must be implicated, since Phillipp has trans-

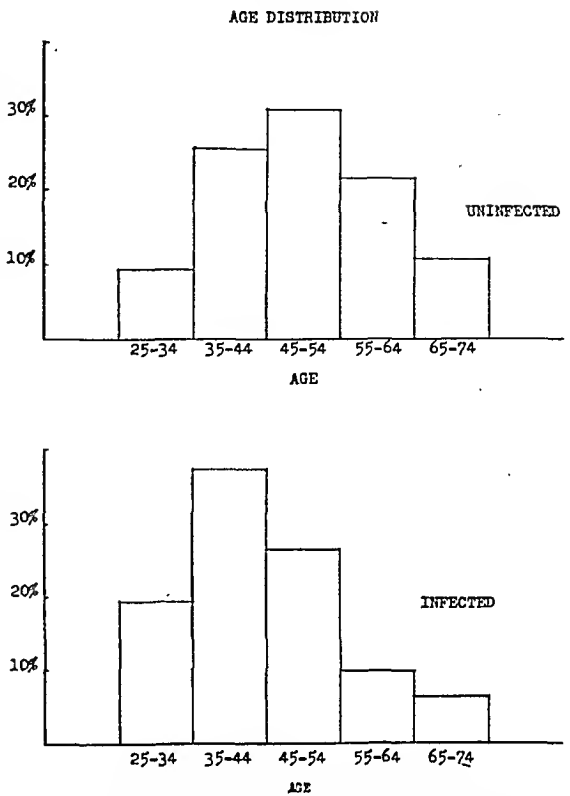


Fig. 1. Carcinoma of the cervix: age distribution of uninfected and infected cases.

formed banal streptococci into pathogenic organisms by tamponage.

Cases 4 and 5 illustrate the tendency to the development of infection manifested by patients in whom the carcinoma is complicated by pregnancy, the puerperium, or lactation. We had 11 such cases altogether and in 9 there were serious septic complications. The cases alluded to also demonstrate the occurrence of thrombosis in the deep pelvic veins (although we have proof only in Case 5). According to Collins and his staff, who have studied the question extensively in this hospital, this complication must occur more frequently than is usually reported (Nelson, Jones, and Collins). Ducuing was of the same opinion and reported thrombophlebitis in 5 per cent of his private cases; in the majority, however, the thrombus occurred in the femoral vein, which was also the site of the lesion in the two cases appearing in Table I.

The interrelations of radiation and infection are complex and remain incompletely

TABLE VI: THREE-YEAR END-RESULTS IN 449 CASES OF CARCINOMA OF THE CERVIX

Stage	I	II	III	IV	Total
Infected					
No. of cases.....	7	41	67	26	141
Three-year survival rate.....	57%	32%	22%	4%	23%
Uninfected					
No. of cases.....	28	91	152	37	308
Three-year survival rate.....	82%	68%	34%	5%	44%

understood. Regaud held that radiation aggravates infection by enfeebling the tissue defenses and creating a favorable terrain for bacterial proliferation. In what may seem a direct contradiction, the administration of external x-ray therapy has been recommended as an effective method of clearing up infection by Coutard, Ernst, Healy, Hurdon, Martin, and others. Van Damme, den Hoed, and Laborde employ small doses of radium for the same purpose. den Hoed has demonstrated the beneficial effects of this method with the aid of the Ruge-Phillipp virulence test. Other investigations with bacteriologic control have failed to yield consistent results. Furthermore, x-ray therapy is known to produce acute febrile reactions causing the cessation of treatment in 4 to 10 per cent of the cases (Ducuing). At Charity Hospital, treatment has almost invariably been begun with external x-ray therapy, and during its administration pelvic cellulitis developed in 11 and pelvic peritonitis in 3 of our patients. There were no hospital deaths in this group, and the median survival period was twenty-two months.

In 69 of our cases infection was considered too severe for us to attempt radium therapy. Pervaginal x-ray therapy proved successful in some of these cases, but the group is too small to permit worth-while comparisons. The radium technic employed is a modification of the Paris method and consists of two fifty-hour applications separated by an interval of twenty-four hours. Despite preliminary x-ray therapy, local disinfection, and a careful aseptic technic, infectious complications occurred in one-fifth of the 290 cases selected for radium therapy. The immediate mortality

is shown in Table II. The more severe reactions encountered are illustrated by Cases 5 and 6.

The remote effects of infection are apparent in the survival curves of Figure 2 and in the end-results shown in Table VI. For comparative purposes of this sort, the three-year rates given are probably satisfactory, especially in view of the fact that the findings are consistent with the five-year rates presented by Goldscheider. In both series the survival rates are significantly lower in the cases with febrile reactions.

TABLE VII: INFLUENCE OF COMPLETENESS OF TREATMENT IN CARCINOMA OF CERVIX

	Complete Treatment	Incomplete Treatment
Infected		
No. of cases.....	53	88
Three-year survival rate.....	47%	7%
Uninfected		
No. of cases.....	218	90
Three-year survival rate.....	53%	12%

In Table VII a comparison of the cases with regard to the completeness of treatment discloses no significant difference between groups similarly treated, and we are led to conclude that the inferior results in the entire class of infected cases is due to inadequacy of treatment and not to inherent radioresistance. This suggests that, with effective methods of controlling infection, full treatment could be given to every case and the salvage for the entire material would thereby be substantially improved. A similar analysis of the cases reported by Goldscheider, however, fails to confirm these views. She finds discrepancies of the order noted before, even when only cases fully treated are compared—52 per cent five-year survival rate for the apyrexial cases, 14 per cent for the infected. The apparent contradictions in the two series could probably be reconciled only by determination of the actual tissue doses delivered, giving due consideration to the time required for the administration of treatment.

Prophylaxis of the infectious complica-

tions of radium therapy by the methods usually recommended has proved ineffectual in a substantial proportion of the cases, as indicated above. Since the temperature and the leukocyte count may be normal in patients harboring virulent organisms, an effort has been made to detect latent infection by other means. With this end in view, the blood sedimentation time has been determined in our cases, by the method of Linzenmeier (see Ponder). Interpretation of the readings is complicated by the effects of anemia, of x-ray therapy (Dunlap), and of the carcinoma itself. The average of the readings among

racy, and probably merits greater attention than is accorded to it in this country.

Once severe infection is established, surgical drainage of pus collections and chemotherapy seem to be the only efficacious methods of treatment. Vaccines, antisera, and other measures have been shown to lack merit in spite of the initial enthusiasm expressed (Mutermilch and Lavedan). The sulfonamide drugs have been tested, and many successes have been reported. We have had failures, but there is no doubt that the drugs can produce an almost miraculous recovery in desperately ill patients (see, for example, Case 6).

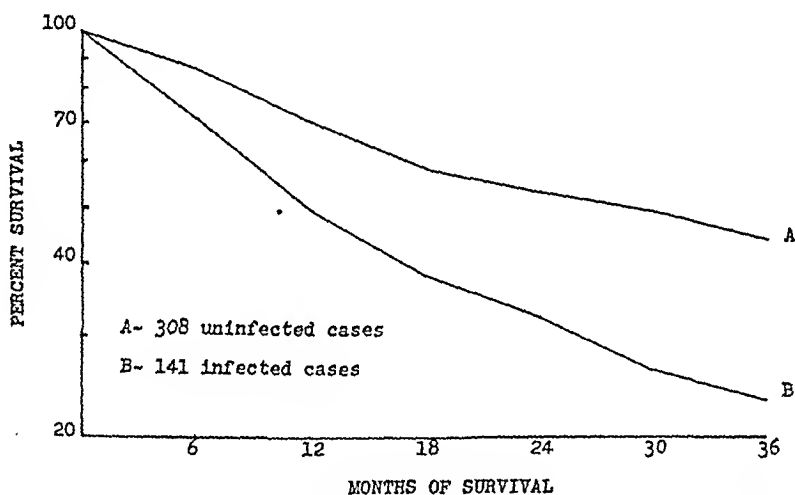


Fig. 2. Carcinoma of the cervix: survival curves for uninfected and infected cases.

the patients who tolerated radium well was 52.5 minutes; among those with interruptions of the radium therapy, 36.5 minutes; among those in whom no radium therapy was attempted, 25.9 minutes. These values clearly reflect the severity of infection in the groups as a whole. Unfortunately the determinations in the individual case are subject to fluctuations that prevent the recognition of any clear lines of demarcation, so that the test has only a limited value for our purposes. We have had no experience with the Ruge-Phillipp test, but it would seem from the evidence furnished by Phillip himself, Clauberg, and others, that it can be relied on to foretell the possibility of serious complications in individual cases with a fair degree of accu-

Penicillin became available to us in the spring of 1944, and it was decided to use it in cases with infectious complications meeting the criteria specified in a previous paragraph. Twenty cases have been treated with the drug. They represent the infected material among 69 consecutive admissions from Feb. 24, 1944, to July 1, 1944, an incidence of infection of 29 per cent. None of the cases treated had bacteriological control, the degree of infection being assessed on the basis of the temperature curve.

Eleven patients had fever prior to the institution of radium therapy. The previous policy for handling the problem was to give the patients x-ray therapy if possible and, if the infection failed to clear up,

to allow an additional cooling-off period of four weeks or more. In the 11 cases mentioned, penicillin was given at once and radium therapy was completed while the drug was being administered. All of the patients tolerated treatment without incident. A sample case history is given below (Case 7).

Six other patients had pelvic cellulitis or peritonitis precipitated by the application of radium. In 3 the penicillin was given as soon as the infection developed, while in the other 3 it was started after a cooling-off period had failed to bring about improvement. In all 6 cases the drug controlled the infection, so that it became possible to administer the supplementary radium therapy required almost immediately. An illustrative case history is appended (Case 8).

The remaining 3 patients had completed their radiation therapy and had been kept in the hospital because of pelvic cellulitis associated with uncontrolled carcinoma. Two of these patients also had urinary tract infection and in both instances penicillin failed to produce any improvement (see Case 9).

After a period of trial, it was found that satisfactory results can be obtained when the drug is administered intramuscularly every three hours at the rate of 200,000 Oxford units a day. No significant toxic reactions were encountered. Although our experience with the drug is limited, we are convinced that penicillin is an important additional weapon in combating the infection associated with carcinoma of the cervix.

SUMMARY

The morbidity and mortality from infection are analyzed in a group of 449 cases of carcinoma of the cervix treated at the Charity Hospital at New Orleans in the three-year period ending March 31, 1941. The infectious complications and their predisposing factors are discussed and the influence of infection on the plan of treatment and on the three-year end-results is considered. Experience with penicillin therapy in 20 more recent cases is reported.

CASE REPORTS

CASE 1: C. J., colored, age 54, admitted Jan. 13, 1940, with carcinoma of cervix, stage III. Biopsy: squamous-cell carcinoma, grade III. Temperature normal. Sedimentation time 40 minutes. Urinalysis: 10-15 W.B.C. per H.P.F. Stained urinary sediment: Gram-negative bacilli (not suggestive of *B. coli*) and few short-chain streptococci. Blood urea 14 mg. per cent. P.S.P. 17 per cent. Wassermann reaction strongly positive.

External x-ray therapy was begun on Jan. 17, 1940. Routine cystoscopy, Feb. 2, showed urethral stricture, acute cystitis, and obstruction of the left ureter 2 cm. from the orifice. That night the temperature rose to 102.4°, and the following morning to 104.2°, with severe chill and collapse. The urine was loaded with pus, Gram-negative bacilli, and Gram-positive cocci. X-ray therapy was discontinued. Intravenous fluids and other supportive measures, followed by methenamine, gradually brought the temperature down to 101°. On Feb. 7, the fever again became higher; N.P.N. was 66 mg. per cent; red blood cell count 3,090,000; white cell count 9,900 with 98 per cent neutrophils. Sulfanilamide therapy was instituted, with no improvement. Two days later the blood urea was 107 mg. per cent, creatinine 5.5 mg. per cent. Despite all measures, the patient died with uremia on Feb. 11, 1940. Autopsy showed carcinoma of the cervix with metastases to the periaortic lymph nodes, gangrenous cystitis, acute ascending bilateral pyelonephritis, and left ureteral obstruction.

CASE 2: A. L., colored, age 37, was first seen in the Outpatient Clinic on June 22, 1940, with everted carcinoma of the cervix, stage III, and uterine fibroids. Biopsy: squamous-cell carcinoma. External x-ray therapy was instituted. On July 11, 1940, the patient was admitted to the hospital because of abdominal pain and tenderness and fever. Four days later the temperature rose to 105°, with chilly sensations and abdominal distention; the red blood cell count was 2,260,000, white count 18,450, with 83 per cent neutrophils. Passage of a uterine sound elicited a foul purulent discharge. A diagnosis of pyometrium and pelvic peritonitis was made. Dry heat and supportive measures brought the fever down to 102° in twenty-four hours, but it persisted at 100 to 101.6° for four weeks. Perineal x-ray therapy was given subsequently, but persistence of the pyometrium for four months made radium therapy impossible. The patient died of extension of the carcinoma six months after admission.

CASE 3: M. F., white, age 39, admitted Nov. 8, 1939, with carcinoma of the cervix, stage IV (extension to the labia minora). Biopsy: keratinizing squamous-cell carcinoma. Temperature 99.4°. Hemoglobin 7 gm. (40 per cent). Red blood cells 2,200,000. White blood cells 8,400, with 87 per cent neutrophils. Sedimentation time 50 minutes.

X-ray therapy was instituted on Nov. 13, 1939. Two days later severe hemorrhage occurred and the vagina was packed. The temperature rose to 102.6°. A transfusion was given. The packing was removed in twenty-four hours but had to be reinserted on several occasions. Repeated transfusions were given. The temperature continued between 102 and 104° and death ensued Dec. 2, 1939, from hemorrhage and sepsis. Autopsy showed necrotic carcinoma of the cervix with a small vesicovaginal fistula, secondary anemia, ulcerative cystitis, congenital right double ureter, and bilateral hydronephrosis.

CASE 4: M. B., white, age 37, admitted Oct. 15, 1940, with a friable tumor of the cervix, five-months' pregnancy, and abdominal cramps. Biopsy: squamous-cell carcinoma. Sedimentation time 30 minutes. On the night of admission abortion occurred, with expulsion of a female fetus 22 cm. long. The following day the patient had a severe chill, with fever of 103° and a foul lochial discharge. The hemoglobin was 66 per cent, red blood cell count 4,010,000, white cell count 15,120, with 86 per cent neutrophils. Sulfathiazole therapy was instituted and repeated transfusions were given, but chills and fever of 103 to 105° continued till Oct. 22, when a remission occurred. The patient was then considered too ill for even external x-ray therapy. On Oct. 26, the former course of the illness was resumed, with three or four chills daily, fever of 102 to 105°, vomiting, diarrhea, and abdominal distention and tenderness. On Nov. 7, the patient suddenly became dyspneic and had a circulatory collapse, from which she rallied. X-ray films of the chest were negative until Nov. 14, when they disclosed multiple pulmonary infarcts. Later the liver became enlarged and tender, and jaundice developed, with an icterus index of 50. Metastatic abscesses appeared in the right hand and left preauricular region. Subsequently left supraclavicular adenopathy occurred. Blood cultures were negative on five occasions: blood urea was 24 mg. per cent. Death occurred in coma, with a temperature of 106°, on Nov. 19, 1940. The final diagnosis was carcinoma of the cervix complicated by pregnancy, puerperal sepsis, and peritonitis. We believe the patient had pelvic thrombophlebitis and pyelophlebitis.

CASE 5: A. T., white, age 25, admitted June 1, 1940, with carcinoma of the cervix, stage III, and a history of chills and fever. Biopsy: squamous-cell carcinoma.

The patient had had a sanious vaginal discharge since delivery five months previously. She was still lactating. The hemoglobin was 80 per cent, the sedimentation time 15 minutes. A septic fever continued for four weeks, despite administration of sulfanilamide and sulfapyridine, ranging between 101 and 104°. Chest films were negative, as were blood smears and agglutination tests. There was no pyometrium, no pelvic abscess. On June 29, cystoscopy showed bullous edema of the bladder. The ureters

were not obstructed, but there was slight stasis in both kidneys, with hazy urine. Indigo carmine concentration by the left kidney was impaired. The impression was that the patient had a pyelonephritis. A bilateral pyelogram was negative and a urine culture was sterile.

External x-ray therapy was begun on July 5 and completed four weeks later. There was a transient reduction in fever with irradiation, but the septic course continued and the temperature became normal only a few days before discharge, on Aug. 27.

The patient was readmitted, improved, Sept. 27, 1940. In the interim she had been symptom-free except for a sanguineous vaginal discharge. The temperature was normal, the sedimentation time 30 minutes. On Oct. 4, radium was applied within the uterus and vagina. Eight hours later the temperature rose to 104°, with a chill. The radium was removed, but the temperature continued to rise, reaching 106°. Sulfanilamide therapy was instituted. The hemoglobin was 75 per cent, red blood cell count 4,500,000, white cell count 6,750, with 70 per cent neutrophils. A blood culture was negative. Repeated transfusions were given, and oxygen was administered by catheter. Chills continued, however, with fever of 101 to 104° and, despite all measures, the patient died in stupor, Oct. 11, 1940, with dependent edema, faint icterus, and abdominal distention. Autopsy showed carcinoma of the cervix with endo-, myo-, and parametritis, thrombophlebitis of the uterine and ovarian veins, cystitis, bronchopneumonia, and pyelonephritis.

CASE 6: S. E., white, age 34, admitted Nov. 28, 1939, in shock from vaginal hemorrhage due to fungating carcinoma of the cervix, stage II. After the emergency had been successfully handled, biopsy showed squamous carcinoma of the cervix (transitional type). The Wassermann reaction was strongly positive; temperature normal.

X-ray therapy was administered from Dec. 5 to Dec. 29, 1939. On Jan. 5, 1940, radium was applied for fifty hours, the maximum temperature being 99.6°. On Jan. 8 radium was again applied. Twenty-four hours later the temperature rose to 104°, and the radium was removed. The temperature continued to climb, however, reaching 106° (axillary). The patient had severe chills and became unconscious. Rigorous measures were instituted to combat the fever, including iced alcohol, cold water flushes, infusions, calcium gluconate, adrenalin, caffeine sodiobenzoate, and neoprontosil. Sulfanilamide was given by clysis. The temperature remained elevated, however, oscillating around 105°. The following day stimulants, ouabain, infusions, and sulfanilamide by clysis were continued. The temperature was still high, reaching 104.4°, but the condition of the patient was improved and she responded to questioning. On the fourth day the temperature dropped to 102° and on Jan. 13 it returned to normal. Following the acute attack, speech re-

mained somewhat slurred, but the patient regained strength and was discharged on Jan. 28, with no further irradiation. She left the state two months later without evidence of active disease, but death occurred twenty-five months after her original admission.

CASE 7: T. J., colored, age 32, admitted May 6, 1944, with carcinoma of cervix, stage III. Biopsy (four days after admission): epidermoid carcinoma, grade II. Following biopsy the temperature, previously normal, rose to 100.8° , and fever of 99.2 to 103.4° continued for three days. The hemoglobin was 14.2 gm., red blood cell count 5,200,000, white count 5,200, with 78 per cent neutrophils. Penicillin was given at first intravenously, then intramuscularly. Within two days the patient was afebrile, and on the fifth day radium was applied. Exposure was for fifty hours with a maximum recorded temperature of 100.2° . Penicillin and radium therapy were then discontinued simultaneously after a total dose of 325,000 Oxford units of the drug. External x-ray therapy was given a month later. At its completion, Aug. 7, 1944, the cervix had not healed entirely, but the patient was in excellent condition.

CASE 8: W. B. C., white, age 29, admitted March 31, 1944, with carcinoma of the cervix stage II. Biopsy: keratinizing squamous-cell carcinoma. The cervix showed a ragged central crater and considerable suppuration. X-ray therapy was given in the Outpatient Department from April 3 to May 15. The patient was readmitted on May 16, with little change in the appearance of the cervix. The temperature was normal. On the following day radium was applied in the uterus and vagina. The temperature began to rise that evening and by five o'clock the next morning reached 104.2° . The radium was removed and penicillin was given, for the most part intramuscularly. The temperature fell to 101° the same day and by the third day was normal. Radium was reapplied for fifty hours on May 24 and for thirty hours on May 27. During the second application a transient rise of temperature to 102° occurred. Radium and penicillin were discontinued at the same time on May 28, after administering 1,412,500 Oxford units. After being afebrile for two days, the patient was discharged on May 31. She reported for observation on Aug. 10, 1944, apparently in good health, without evidence of residual disease.

CASE 9: O. G., white, age 34, admitted Feb. 10, 1944, with stage III carcinoma of the cervix. Biopsy: non-keratinizing squamous-cell carcinoma. X-ray therapy to the pelvis was begun but was discontinued when severe jaundice developed, March 16. All diagnostic tests indicated that the jaundice was of obstructive origin. An exploratory laparotomy on March 31 disclosed obstruction of the common bile duct by a group of enlarged lymph nodes. These were removed and were found to represent chronic lymphadenitis. Biliary tract drain-

age was established, and the jaundice rapidly subsided. External x-ray therapy was then resumed, being completed on May 4. Following the completion of x-ray therapy, the patient continued to have fever, which gradually increased until daily temperature elevations of 102 to 103° were occurring. Repeated cystoscopic examinations and pyelograms revealed bilateral pyohydronephrosis. Bilateral nephrostomy was performed, but in spite of adequate drainage, sulfonamides, and urinary antiseptics, the temperature continued to spike to 102° or 103° daily. In an attempt to control the infection, the patient was placed on penicillin, 200,000 Oxford units per twenty-four hours. This was continued for ten days, with a total dose of 1,975,000 units. During the course of administration, the patient's temperature was not affected. It dropped to normal on the day the drug was discontinued, remained normal for five days, but then resumed its former trend. The septic course has continued unaffected by the drug (Aug. 31, 1944).

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Indications and Limitations of Transvaginal Roentgen Therapy for Cancer of the Cervix¹

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IF THE RAYS WE use to destroy cancer cells, or to inhibit their growth, were harmless to all other cells, the solution of the problem of how to cure cancer of the cervix would be easy. We could deliver to every part of the pelvis a lethal cancer dose of roentgen rays, which is now considered to be about 6,000 r. But x-rays are not innocuous, and if we tried to administer, in a short time, such an enormous dose to such a large area, few of our patients would recover. We must compromise between the ideal and the practical. In this country, it is now pretty generally agreed that the best plan of attack on cervical cancer is to administer to the primary tumor, in and around the cervix, a destructive dose, or as nearly a destructive dose as we dare to give. This is supplemented by a smaller dose to the entire pelvis, which we believe, or at least hope, is large enough to inhibit the growth of cancer cells.

The most commonly employed method of destroying the primary tumor is to use tubes of heavily filtered radium in colpostats in the lateral vaginal fornices, in combination with an intra-uterine tandem. Although gamma rays have great penetrative power, radium must be placed so close to the tissues to be treated that its action is uneven. With the best possible technic, not more than 30 per cent of the surface dose reaches a depth of 3 cm. (1). This means that, if we deliver a destructive dose to the third centimeter of tissue, the first centimeter receives more than three such doses.

The Chaoul technic is also used to deliver a destructive dose of roentgen rays to the cervix. The tube itself is inserted into the vagina and, with good technic (100 kv. and 5 cm. A.S.D.), the distribution of the

radiation is about the same as with good radium technic, but no better. About 28 per cent of the surface dose reaches a depth of 3 cm. (2).

The transvaginal method of direct roentgenization of the cervix, introduced by Merritt (3, 4), in what I believe to be the most valuable contribution to radiotherapy since the adoption of the international unit, is by far the most efficient method of destroying the primary tumor. The principal objection to it is the difficulty of exposing a field large enough to include the entire lesion and the lateral fornices. Incidentally, this is a good place to say that the treatment of cervical cancer through radio-opaque cylindrical specula, exposing a single field smaller than the lesion, is hopelessly inadequate and should be abandoned. Merritt exposes a large field by using a speculum transparent to the rays, allowing the expanding beam to pass through a part of the vagina. Wasson and Bouslog (5) do it by using multiple overlapping fields, and we do it by retracting the vaginal walls (6, 7, 8).

In our modification of the transvaginal method of irradiation, the following physical factors are employed: kv. 200; ma. 20; A.S.D. 25 cm.; effective filter, Cu 0.75 mm.; hardness expressed as half-value layer in copper, 0.9 mm. The short distance is used to take advantage of the rapidly expanding beam, to shorten the time of the treatments, and to lessen the danger of overexposing the rectum. We can usually expose an oblong field 5×6.5 cm., or two half-oval fields which, combined, measure 5×7 cm. Seventy per cent of the surface dose reaches a depth of 3 cm. Our measurements also show that the depth-dose percentage at 3 cm. is 58

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with the following factors: kv. 135; ma. 5; A.S.D. 25 cm.; filter, Cu 0.25 cm.; hardness, expressed as half-value layer in aluminum, 8.0 mm. Braestrup's (9) recent study of the distribution of similar rays shows that the percentage of the surface dose reaching the third centimeter is 59 at 20 cm. A.S.D. and 64 at 30 cm. A.S.D. His findings agree with those of other accurate investigators (10, 11, 12).

This all means that there can be no doubt that, using at least 135 kv., and copper filters at least 0.25 mm. thick, we can, if we choose, deliver an aggregate dose of 6,000 r to the tissues at a depth of 3 cm. without producing necrosis of the surface of the cervix. Such an accomplishment is impossible by any other known method. With such dosage and distribution, we should expect to get improved clinical results, and we do. I believe that all those who have used the transvaginal method will agree that their results justify a definite statement that the method is indicated in every case in which it can possibly be used.

There are several objections, limitations, and contraindications to transvaginal therapy, the most frequent being that suitable apparatus is not available. It is true that few 200-kv. tube stands are designed to be used at short distances, but most of them can be modified. If they cannot be so modified, we all have, or should have, 135-kv. shock-proof therapy apparatus which will produce a beam of rays with much better distribution, as I have already pointed out, than the best radium or the best Chaoul technic. Any mechanic can make in a few hours a simple speculum such as the half-oval instrument which we sometimes use, so that the problem of obtaining suitable apparatus is not insurmountable.

Vaginal atresia is, of course, a definite contraindication to the use of the method. Vaginismus and the narrowness of the vagina sometimes seen in spinsters and childless women make the introduction and expansion of the speculum painful and sometimes impossible. In such cases, we do not hesitate to give the treatments under nitrous oxide or intravenous anesthesia.

Pelvic infection, and especially retention of pus in the uterus, has long been considered a contraindication to radium therapy. In less degree, it at least postpones transvaginal treatment until the cross-fired series is well under way and the infection has been controlled.

Finally, there is the question of how much we should try to do for advanced, apparently hopeless cases. Unquestionably, many patients with advanced cancer receive satisfactory and sometimes unexpected palliation from roentgen therapy. On the other hand, transvaginal treatment is, at best, an unpleasant procedure. When it appears futile to expect a cure, it is probably good judgment to restrict such treatment to the cases in which response to the cross-fired treatment indicates a radio-sensitive tumor, or to use it for such palliative effect as the control of hemorrhage.

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DISCUSSION

(Papers by Garcia and Schlosser and by Erskine)

Edwin C. Ernst, M.D. (St. Louis, Missouri): Dr. Garcia and Dr. Schlosser are to be complimented for again calling our attention to the septic reaction factors in carcinoma of the cervix. This subject is very timely and vitally important in the interest of improving our present survival rates—this for the reason that occasionally we are forced to modify and perhaps prolong our planned irradiation programs because of these severe reactions and inflammatory complications. Especially is this subject opportune in view of the many new and apparently effective drugs which have been developed during this present decade, for all forms of infection, particularly those forms resistant to early treatment.

I realize that at present the scarcity of some of these drugs is a severe handicap. I know it has been to us. I do not refer to the immediately fatal cases following radium application without preliminary x-ray therapy, which are important, of course, but to those patients presenting *minor and major* infections, especially of the genito-urinary tract, prior to and during the course of the treatment. Since the advent of preliminary roentgen therapy in our groups and careful medical check-ups, the situation as regards complications, and especially infection factors, has been improved. Nevertheless, there is room for further improvement, and our past experience would warrant the prediction that this will be effected if we are fortunate enough to eliminate most of these apparent febrile reactions following irradiation and necessitating its discontinuance.

I am looking forward to obtaining a generous supply of these drugs, particularly penicillin, which we have employed to some extent in the past. I hope that in the group which the author mentions, patients under forty (they really have been problem children for us), we can better treat carcinoma of the cervix with infection.

We have, of course, all observed that occasionally severe infection of the pelvis, general low-grade infection, and other changes respond almost miraculously to irradiation. At the same time, smaller and apparently less formidable lesions may fail to react. The danger then lies from infection reducing or unnecessarily prolonging the timing of our planned irradiation; what we consider ideal timing for our treatment is changed, thus handicapping our vital cancer problem by inadequate dosage. This may not prove to be the all-important factor, but I personally believe it merits our future attention.

In reference to transvaginal roentgen therapy as discussed by Dr. Erskine, I agree with most of the enthusiastic premises as he presented them in reference to the indications for and limitations of this method. I am sure that we all appreciate the logical necessity and the essential requirement that lethal doses reach the cervix and the surrounding pelvic

structures if treatment is to be effective. That we must occasionally compromise between the practical and ideal, in the interest of the local cervical lesion, is self-evident. Any one of a variety of methods must be selected to meet the needs of the individual case. All in all, direct intravaginal x-ray therapy procedures require a great deal of skill and personal supervision, which is as it should be, no matter which method or methods may be selected.

Technical difficulties in employing the transparent specula first suggested by Merritt and the ingenious multiple ports of Wasson and Bouslog, together with the psychological fact of a reluctance by some of us to abandon the old, orthodox method of direct intracervical radium applications, have perhaps been to a large extent retarding factors, preventing the more universal use of transvaginal therapy. In selected cases I have employed this method with increasing frequency and with good success, although I have been unable to complete comparative studies. Thus far I have conservatively remained reluctant to abandon completely the intracervical and vaginal forms of radium application in stages I, II, and III.

I have been, most naturally, intrigued by the differences in the respective depth doses with direct x-ray therapy and our usual radium application, and I have worried, perhaps unnecessarily, regarding the probably limited effective lateral wall roentgen distribution when the average transparent specula were employed. Apparently the vaginal dilator, as shown by Dr. Erskine, may be the answer to my prayer and will renew my unqualified faith in this method of attacking the cervical cancer problem.

Chas. L. Martin, M.D. (Dallas, Texas): There has been very little written on infection in carcinoma of the cervix and I consider the paper by Drs. Garcia and Schlosser one of the best that has come to my attention. It has been my custom to assume the complete care of patients with cervical cancer and in some instances the treatment of the ever present infection becomes more difficult than the treatment of the malignant condition.

In our Clinic, the first step consists in the removal of all presenting tumor tissue, the drainage of the uterine cavity and pockets of pus within the tumor, and the coagulation of all bleeding points under sodium pentothal anesthesia. Before this procedure is carried out, the vagina and the tumor are thoroughly scrubbed with green soap. Although some temperature elevation is likely to follow this cleaning up process, the free use of soap has reduced such reactions to a minimum. The removal of excess tumor tissue enables us accurately to approximate radium applicators to the remaining tumor tissue in a dry field, thereby reducing the necessary total dosage. I note with some satisfaction that the essayists do not advocate the local use of antiseptics or sulfa drugs, since such therapy has not been successful in our hands.

When a temperature elevation appears, with an

elevation of the pulse rate, and an appreciable increase in the white count is accompanied by a shift to the left, one of the complications described by Dr. Garcia has occurred and full doses of sulfathiazole should be started immediately. The prompt institution of this treatment is most important, because it is of little value after abscesses form. Although sulfa drugs have produced very satisfactory results in our Clinic, Dr. Garcia's results indicate that penicillin has many advantages, and I hope I may be able to use it in the future.

Although most radiologists use x-ray therapy first in an effort to clean up infection, our experience parallels that of Dr. Garcia, who has observed an aggravation of febrile reactions during intensive external irradiation, particularly in the neglected case with abscess formation. My chief reason for employing x-ray therapy as a secondary procedure is the difficulty which we have experienced in attempting to place large radium applicators in the fornices after the vaginal contraction following external irradiation has taken place.

Dr. Erskine's ingenuity in perfecting cones for intravaginal therapy deserves the highest commendation. Since I have never used the method, I am really not competent to discuss his paper. In my opinion the procedure has two weaknesses. Reference to a drawing of a sagittal section of the pelvis shows that a speculum inserted into a normal vagina must of necessity point directly at the anterior wall of the rectum. I find it difficult to believe that the rectal mucosa can successfully recover from the dose of 6,000 r delivered to a depth of 3.0 cm. below the surface. Most of us have attempted to work out radium and x-ray technics designed to irradiate efficiently extensions into the broad ligaments and the tissue between the cervix and the bladder. Again, reference to our drawing indicates that the effective beam from the vaginal cone passes well behind these areas. I hope that Dr. Erskine will explain away my theoretical objections to his method.

Robert E. Fricke, M.D. (Rochester, Minn.): I wish to discuss the paper of Dr. Garcia and Dr. Schlosser, "The Problem of Infection in Carcinoma of the Cervix." I think the amount of complication encountered depends a great deal on judgment in determining the type of treatment to be given. All radium therapists are burdened with a great many cases in which the condition is in stage IV or stage III; the patients are anemic, in poor general condition, and may complain of urologic difficulties. Often a kidney is not functioning. Then it is best not to attempt a complete course of radiotherapy, even though it would offer the only chance of cure, but to administer limited treatment for palliation, the value of which is not sufficiently stressed.

If a limited course of treatment is given, it is possible to achieve considerable palliation. The radium therapist gets into trouble when he becomes too

enthusiastic and tries to give a complete course to a patient who cannot tolerate it.

The sulfa drugs and penicillin have helped a great deal. In 1943, we treated 148 new patients with cancer of the uterine cervix at the Mayo Clinic, and for the first time in my experience we had no deaths. I know the sulfa drugs and penicillin saved many seriously ill patients.

Arthur W. Erskine, M.D. (*Closing*): In regard to Dr. Martin's question about over-irradiation of the rectum, we find that by prying up on the outer end of the speculum we can introduce it practically parallel with the long axis of the patient, even though she does not have a retroversion. In this way, we can avoid over-irradiation of the rectum. In about 130 or 135 cases we have had only four instances of severe proctitis.

What are we trying to do when we treat cancer of the cervix? There is one thing that we should be sure that we accomplish if we possibly can. We should at least be sure that we destroy the primary lesion. Sometimes when we treat a patient with what we think is Group I or Group II cancer of the cervix, the primary lesion heals, but a few months or a year later the patient dies of a metastasis deep in the pelvis. We comfort ourselves by saying to ourselves that our original classification was wrong; that the patient, when we treated her, already must have had a Group III cancer with distant metastases.

On the other hand, we have patients that we classify as Group III, because of some palpable nodes along the sides of the uterus or because of some fixation of the organ, who nevertheless recover and stay well. Ought we not, in common honesty, when such a thing happens, say, at least to ourselves, that our original classification was wrong and that the patient should have been put into Group I or Group II and that what we felt were inflammatory nodes—nodes due to infection—rather than true metastases?

I doubt very much if we can cure metastatic cancer, and in this connection I would like to read a paragraph from a letter received from Dr. Merritt:

"I have read your paper very carefully and my only suggestion is to place a little more emphasis on the question of curing Stage III and IV, or rather *not* curing such groups. Where glands are palpable I believe they cannot be controlled by radiation any more than cervical lymph nodes in cancer of the lip. Ewing said that the infection accompanying cancer of the cervix was often as serious as the disease itself. The response of infected lymph nodes and induration caused by infection to irradiation is responsible for confusion and mistakes. This is all quite clear if one recalls the experience of Caldwell and Pusey long before the days of deep therapy. Working with gas tubes and little or no filtration, they were amazed at the favorable effects of radiation in cancer of the cervix. They were, of course, treating the infection, not the cancer."

Roentgen Diagnosis of Knee-Joint Effusion¹

CAPT. ARNOLD L. BACHMAN, M.C., A.U.S.

IN THE STUDY of the roentgenograms of a large number of patients admitted to the Station Hospital, Miami Beach Training Base (Miami Beach, Florida), for abnormalities of the knee, changes in the soft tissues have been noted which have greatly facilitated the diagnosis of effusion into the knee joint. These findings are re-

Other references to the findings to be described have not been discovered.

A brief description of the pertinent anatomy of the knee with particular reference to its roentgen appearance seems warranted. Figure 1, A, represents a mid-sagittal section through the knee, drawn from Gray (1) and Spalteholz (8). It will

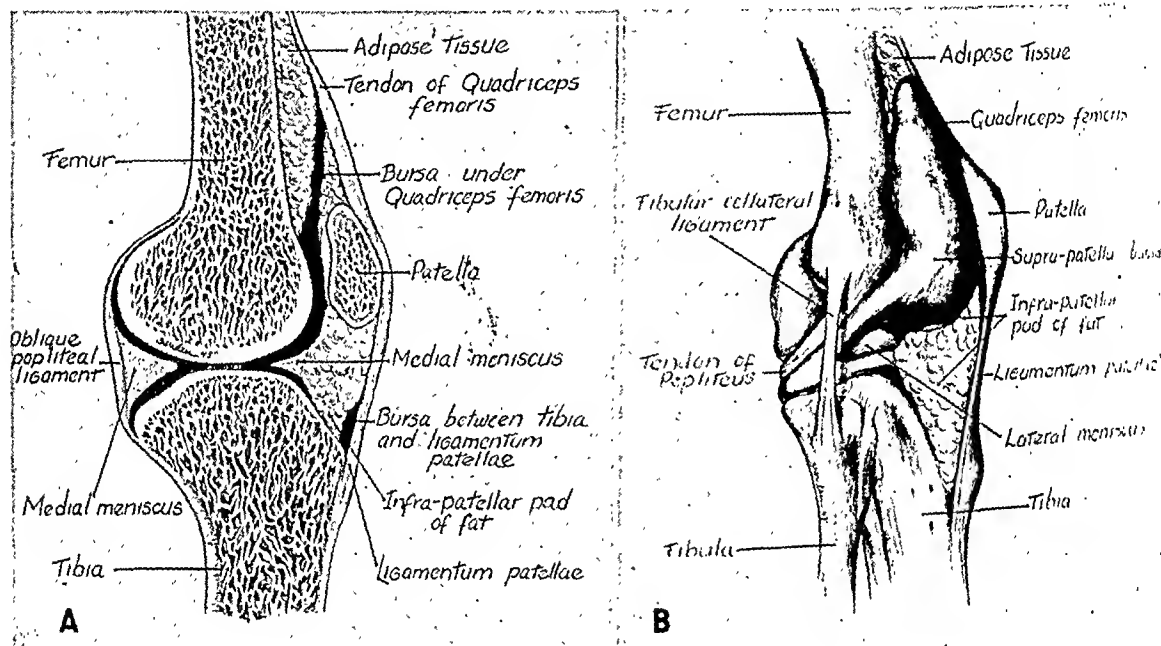


Fig. 1. A. Mid-sagittal section through normal knee joint. B. Appearance of knee joint distended with fluid.

ported since the usually accepted roentgen signs of knee-joint effusion, *i.e.*, anterior displacement of the patella and widening of the joint (3) have been found entirely inadequate in the x-ray diagnosis of this condition.

In a review of the literature, it was found that Lewis (4) mentions the presence of a pyriform mass in the suprapatellar pouch and bulging of the infrapatellar ligament in knee hydrarthroses, but does not describe these abnormalities in detail. Löhr and Hellpap (6) report a fullness in the recess above the upper portion of the knee cap in the presence of intra-articular effusion.

be noted that the cavum articulare lies just behind the infrapatellar fat pad and then proceeds upward behind the patella to connect with the suprapatellar bursa. The synovia forming the base of the suprapatellar bursa lies in a small recess formed by the posterior surface of the upper portion of the patella in front and the femoral condyles behind. For convenience in description, this space will be designated as the patello-condylar recess. The bursa itself is situated just in front of a considerable amount of fatty areolar tissue overlying the lower end of the femur above the condyles. The upper portion of the bursa is covered in front by the tendon of the

¹ Accepted for publication in April 1945.

quadriceps femoris. Inferiorly, just above the superior surface of the patella, in the patello-condylar recess, the base of the bursa is separated from the tendon by a small triangular mass of fatty areolar tissue. Thus, on the lateral roentgenograms an oval area of comparative radiolucency, about 6 to 10 cm. in length, is seen to lie over the anterior surface of the lower end of the femur just behind the density of the quadriceps femoris tendon. This radiolucency extends downward and anteriorly over the dorsal aspect of the condyles,

front from the main portion of the pre-femoral fat. The linear bursal opacity then merges with the shadow of the quadriceps tendon and loses its identity, since the bursa and adjacent tendon are of the same radiodensity (Fig. 2). Occasionally, the synovia merges with the adjacent quadriceps tendon immediately above the patella without passing through the fatty tissue. In such cases, no linear or band-like synovial density is seen in the lower portion of the prefemoral fatty tissue and no small triangular area of fatty radiolu-



Fig. 2. Radiographic appearance of normal knee joint. The band-like opacity of the synovia in the patello-condylar recess is clearly demonstrated.

across the upper end of the joint space, and over the superior surface of the patella just behind the insertion of the quadriceps tendon (2). The synovia of the base of the suprapatellar pouch passes upward from behind the patella through the lower portion of the area of fatty radiolucency in the patello-condylar recess and, being more radiopaque than the fat, is usually seen as a linear or thin band-like density, 0.2-1.2 cm. in thickness, which separates the small triangular area of fatty radiolucency in

the region of the patello-condylar recess (Fig. 3, A). In about 10 per cent of examinations there is no pre-femoral fatty areolar tissue present, and the quadriceps tendon lies directly over the anterior margin of the femur. In the latter cases, of course, no area of radiolucency lies between the femur and the quadriceps tendon (Fig. 3, B).

In cases of effusion, the fluid in the knee joint accumulates first and to the greatest

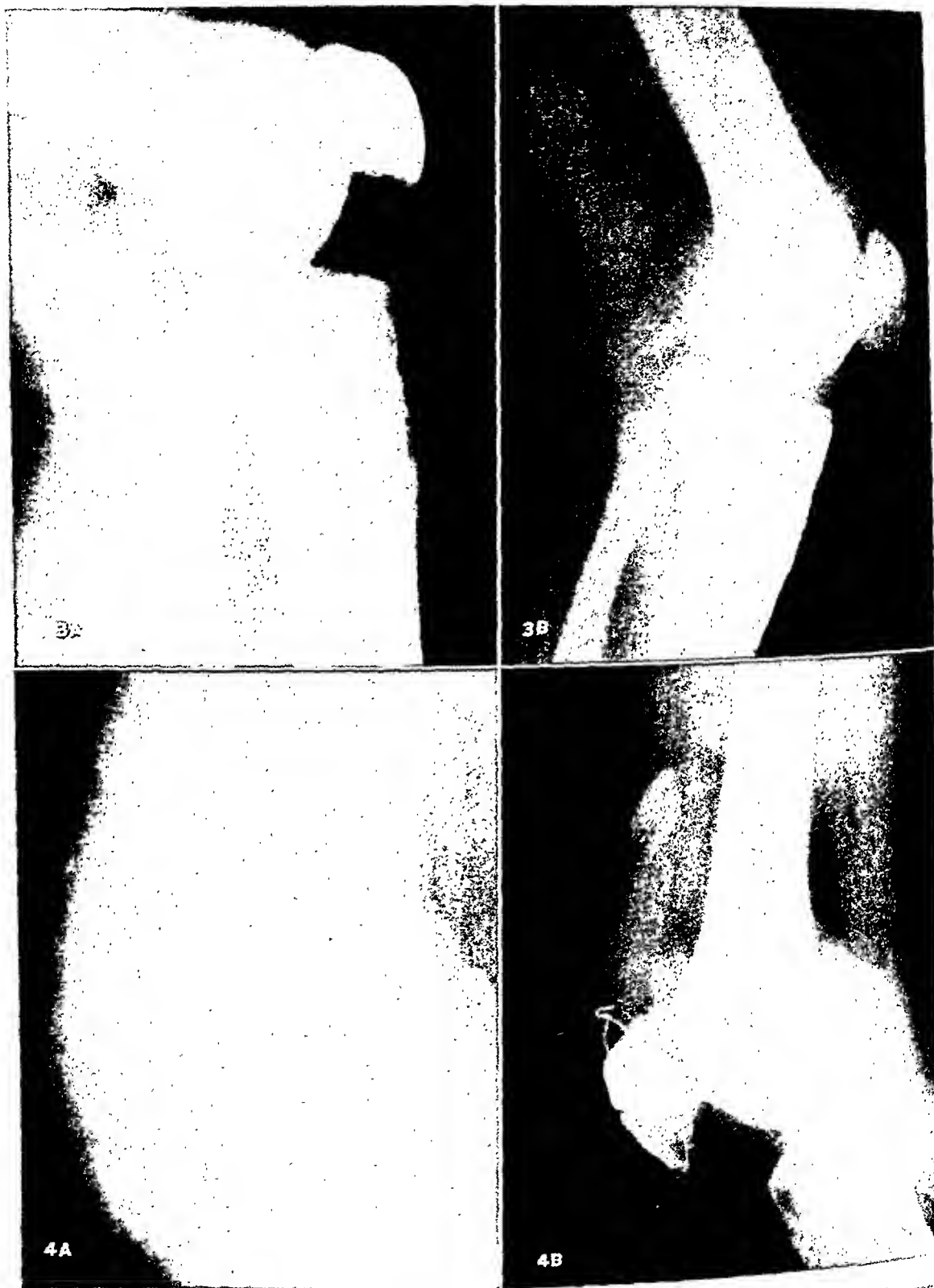


Fig. 3. Normal knee joint. A. Prefemoral fatty tissue extending down to the patella. B. No distinct zone of fatty tissue present over anterior aspect of lower end of femur.

Fig. 4. Case 1. E. G., male, aged 40, was admitted May 7, 1943, having fallen on his right knee while walking. Marked soft-tissue swelling, pain, and tenderness over the knee developed immediately. A roentgenogram (A) showed a transverse fracture through the patella and soft-tissue swelling in front of this bone. However, only a slight increase in the width of the soft-tissue opacity lying within the fatty radiolucency of the patello-condylar

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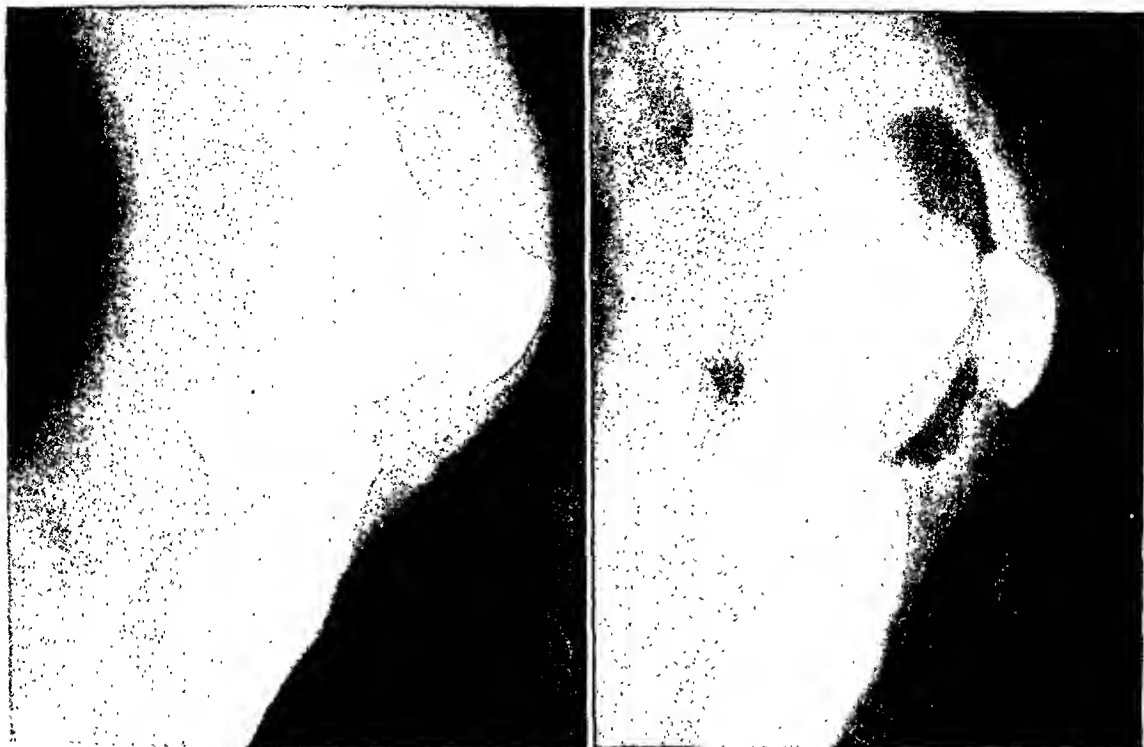


Fig. 5. Case II. O. R., male, aged 19, entered the hospital with a history of having injured his left knee in 1941, a second time in 1942, and again on the day of admission, April 29, 1943. During exercise the knee had buckled and locked. Swelling appeared immediately. A roentgenogram revealed a pyriform soft-tissue mass in the suprapatellar region and anterior compression of the infrapatellar fat pad. Sixty cubic centimeters of bloody fluid were withdrawn and air was injected. A pneumarthrogram showed that the pyriform shadow of fluid density conformed in size and shape with the air-filled suprapatellar bursa. On June 15, 1943, a medial meniscectomy was performed, during which 30 c.c. of serous fluid were removed from the joint.

extent in the suprapatellar bursa. A lesser amount of fluid is located in the space just below the patella and presses the infrapatellar fat pad forward (Fig. 1, B). The smallest quantity of fluid is situated in the joint space between the femur and tibia. As the bursa expands with the fluid, the line or small band of water density between the main collection of prefemoral fat and the small triangular area of fatty radiolucency in the patello-condylar recess becomes increasingly wide. It represents the fluid-distended base of the suprapatellar bursa (Fig. 6). With further accumulation of fluid, the entire bursa becomes dis-

tended. In about half of the cases it can be completely visualized, since in this group the fluid-filled bursa is surrounded by a thin layer of comparatively radiolucent fatty tissue (Figs. 5 and 9). In other cases the bursa is incompletely bordered by the small rim of fatty tissue and is thus visualized only in part (Fig. 7).

The fluid in the joint just behind the infrapatellar fat pad also distends the synovial space and presses the upper portion of the fat forward. This anterior displacement of the upper part of the infrapatellar fat pad is easily recognized on the roentgenogram (Figs. 5 and 8). Further accu-

recess was observed, indicating a very small amount of fluid. The infrapatellar pad was not compressed. On aspiration, 10 c.c. of blood were removed from the joint space. Open operation was performed the following day and a purse-string wire retention suture applied following reduction. At operation only a small amount of fluid was observed in the knee joint. Re-examination on May 19, 1943, showed the patellar fragments to be in good alignment and considerable diminution of the thickness of the soft-tissue opacity between the patella and femoral condyle.

Final re-examination on July 1, 1943 (B) showed the soft-tissue density of the base of the suprapatellar pouch in the patello-condylar recess to be only slightly wider than normal. On clinical examination, the impression was that of a thickened synovia or plastic intrabursal transudate following the patellar fracture. Aspiration of the infrapatellar and suprapatellar portions of the knee joint failed to reveal any evidence of fluid.

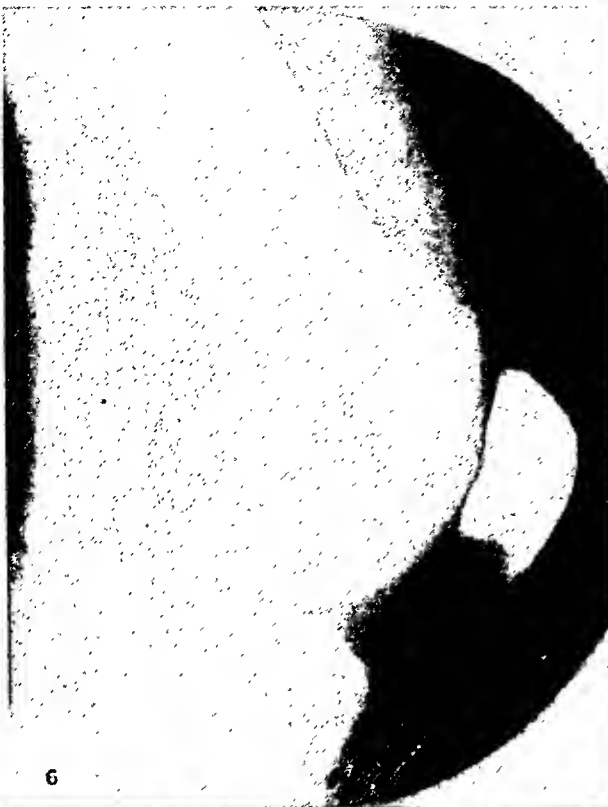


Fig. 6. Case III. J. A. W., male, aged 39, was admitted May 19, 1943, having twisted his knee the previous day. The knee became swollen and tender. X-ray examination on May 20 showed a widened area of fluid radiopacity in the fatty tissue between the upper posterior angle of the patella and the prefemoral fat. The bursa, however, was not clearly delineated. Aspiration of the knee joint resulted in the removal of 60 c.c. of bloody fluid. A pneumarthrogram taken the same day outlined the suprapatellar bursa, which could not be visualized when filled with the fluid alone.

[Legend for Fig. 7 at foot of opposite page]

mulation of fluid in this region pushes the patella itself anteriorly. The weight-bearing portion of the knee joint between the tibia and femur contains a minimal amount of fluid, and widening of the joint is practically never observed except, perhaps, in cases of extreme hydrarthrosis.

Based on the anatomical considerations mentioned above, the following roentgenographic signs have been employed as criteria for the presence of hydrarthrosis in suspected knees:

1. A widened band of fluid density (the distended base of the suprapatellar pouch) in the lower portion of the area of fatty radiolucency between the posterosuperior angle of the patella and the femoral condyle (*i.e.*, the patello-condylar recess).
2. Anterior pressure convexity, mainly of the upper half of the infrapatellar fat pad.
3. Complete or nearly complete delineation of the pyriform fluid-filled suprapatellar bursa (in those cases where the bursae are surrounded by a thin rim of fatty tissue).
4. Anterior displacement of the patella.
5. Widening of the knee joint.

Table I shows the frequency with which the various signs appeared in 20 cases of effusion into the knee joint. In each case, fluid was obtained on aspiration, the amount varying between 20 and 160 c.c. It is apparent that the most reliable sign of effusion is the wide shadow of water density in the area of fatty radiolucency between the upper end of the patella and the femoral condyle, representing the widened fluid-distended base of the suprapatellar bursa. This sign was present in 18 of the 20 cases (90 per cent). In general, the greater the quantity of fluid, the wider was the band-like opacity in the fatty tissue situated in the patello-condylar recess. However, several exceptions to

TABLE I: TWENTY CASES OF KNEE-JOINT EFFUSION

	Width of Soft-Tissue Opacity in Fatty Radiolucency in Patello-Condylar Recess 1.5 cm. or Over	Suprapatellar Bursa Surrounded by Thin Margin of Fat	Anterior Pressure Convexity of Infrapatellar Fat Pad	Anterior Displacement of Patella	Widening of Knee Joint
Definitely positive	18*	5	11	3	0
Highly suggestive	0	4	4	5	0
Slightly suggestive	0	2	0	4	1
Absent	2†	9	5	8	19

* Width of soft-tissue opacity varied from 1.5 to 5.0 cm. Average 2.4 cm.

† Prefemoral fat not present. No radiolucency observed between lower end of femur and quadriceps femoris tendon.

this generalization were noted. In the two cases where there was no prefemoral fatty tissue (and therefore no radiolucency) differential soft-tissue opacities could not be observed above the patella, since the fluid-filled bursa and the adjacent quadriceps femoris tendon were of the same density. The diagnosis in these cases was founded on anterior pressure convexity of the upper end of the infrapatellar fat pad. Anterior convexity of the infrapatellar fat pad due to pressure was present in 15 (75 per cent) of the cases. A completely visualized, pyriform, fluid-distended bursa was observed in 9 (45 per cent) cases. Evidence to suggest anterior displacement of the patella was seen in 8 (40 per cent) of the roentgenograms. In no case was distinct widening of the knee joint observed. This absence of widening was also noted by Löhr and Hellpap (6) in the twenty-six cases they reported.

Hydrarthrosis must be differentiated from soft-tissue tumors, as synovioma, and from diffuse thickening of the synovia without fluid. The soft-tissue tumors appear as well circumscribed opacities frequently irregular in outline, occasionally containing irregular amorphous calcific

Fig. 7. Case IV. D. F., aged 19, was admitted April 22, 1943, having injured his right knee April 8, 1943. The knee became swollen and tender immediately. Swelling persisted until admission. X-ray examination showed no evidence of fracture. A pyriform shadow of fluid density was partially outlined in the prefemoral region just above the patella. Its appearance was highly suggestive of an opaque suprapatellar bursa. There was a wide band of soft-tissue density in the patello-condylar recess. On aspiration 20 c.c. of bloody fluid were obtained. A pneumarthrogram clearly demonstrated that the pyriform soft-tissue shadow corresponded in size, shape, and position with the air-filled suprapatellar bursa.



Fig. 8. Case V. J. L. W., aged 29, entered the hospital May 10, 1943, several hours after injuring his right knee. The knee had become swollen and tender. X-ray examination showed no evidence of fracture. There was considerable fluid opacity in the fatty tissue between the posterosuperior angle of the patella and the femoral condyle, but the suprapatellar bursa was not clearly delineated. The infrapatellar fat pad was compressed forward. Aspiration yielded 30 c.c. of blood-tinged fluid. A pneumarthrogram taken the same day showed the air-filled suprapatellar bursa.

Fig. 9. Case VI. P. T., aged 30, was admitted June 15, 1943, having injured his left knee two days previously. Swelling and pain had developed immediately and persisted. A roentgenogram showed no evidence of fracture. A small, dense, globular, fluid-filled suprapatellar opacity and anterior compression of the infrapatellar fat pad were clearly delineated. On aspiration, 45 c.c. of straw-colored fluid were withdrawn. A pneumarthrogram clearly demonstrated that the suprapatellar pyriform density conformed with the small air-filled bursa.

deposits. They are situated usually about the joint and show none of the cardinal signs of joint effusion (5, 7). Differentiation between thickening of the synovia or intrabursal exudate without effusion and hydrarthrosis can at times be made only with great difficulty. Three examples of synovial thickening or intrabursal exudate were observed. In the roentgenograms there was a widened band of soft-tissue opacity in the fatty radiolucency of the patello-condylar recess almost identical with that seen in effusion. The width of the band, however, tended to be distinctly less than in the cases with fluid. The remaining signs were not present. It is noteworthy that in none of the three cases was there an anterior pressure convexity of the infrapatellar fat pad. The fat pads, however, were irregular in contour and outline and mottled in appearance.

SUMMARY

The roentgen findings in the soft tissues about the knee in cases of knee-joint hydrarthrosis are described. The anatomical

factors in the production of these signs are discussed.

NOTE: I should like to express my appreciation and gratitude to Major O. O. Feaster, Chief of the Roentgenological Service, Station Hospital, Miami Beach, Florida, for his valuable suggestions in the preparation of this article.

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Extrapleural Pneumothorax in the Treatment of Pulmonary Tuberculosis¹

Three-Year to Five-Year Follow-Up of 48 Cases

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THE USE OF extrapleural pneumothorax is not new in the treatment of pulmonary tuberculosis, but the method of managing and maintaining the collapse thus produced over a sufficient period to allow healing of the diseased lung has been developed over the last five or six years. The operation was first performed by Tuffier in 1891, and he reported, in 1910, that he had been able in three cases to maintain the space over a short period by air refills. The same operation has been done by a small number of operators at intervals since that time, using many substances, including air, to fill the space created, but their results were not encouraging. Paraffin packs attained some success, but erosion into pulmonary tissue, through the chest wall and skin, and gravitation downward in the thorax, have made it, at least, not a very satisfactory form of collapse. In 1936, Graf and Schmidt were successful in maintaining their collapse by frequent refills of air over a sufficient period of time to allow healing of the diseased lung. Following the work of these men, this form of treatment has come into widespread use. Though the last word cannot be said for several years, we feel that the procedure has a definite place in our armamentarium against tuberculosis, based on the encouraging results thus far attained.

INDICATIONS

The indications for extrapleural pneumothorax are not as yet definitely set forth and vary with different men practising the procedure. We have not used it to replace any of the tried measures, such as phrenic nerve operations, intrapleural pneumo-

thorax, or thoracoplasty, but have offered it to a group of patients who, in our estimation, were not suitable for these procedures, with the hope that, if it were successful, it would either arrest their disease or so improve their condition as to enable them to stand a thoracoplasty. At present we believe that extrapleural pneumothorax is indicated in those cases in which collapse therapy is desirable but intrapleural pneumothorax cannot be established (or is insufficient because of adhesions which cannot be divided) and thoracoplasty is contraindicated by the nature of the lesion or the condition of the patient. In most of our cases bilateral disease or toxicity due to the exudative and destructive character of the lesion has constituted a contraindication to thoracoplasty.

OPERATIVE TECHNIC

Preoperative Preparation: The preparation for extrapleural pneumothorax is the same as for thoracoplasty; the same measures are taken for sputum drainage and the same preoperative medication is given. The majority of the patients are much sicker than are those treated by thoracoplasty.

Operation: The patient is placed on the table on his side, as for thoracoplasty, and the head of the table is lowered 15 degrees so as to aid in drainage of secretions during the operation. Nitrous oxide-ether vapor has been used in the majority of the procedures, the others having been done under local novocaine anesthesia. The posterior paravertebral incision has been employed in most cases, with subperiosteal resection of a two- to three-inch segment of the

¹ Read before the Joint Meeting of the American Roentgen Ray Society and the Radiological Society of North America, Chicago, Ill., Sept. 24-29, 1944.

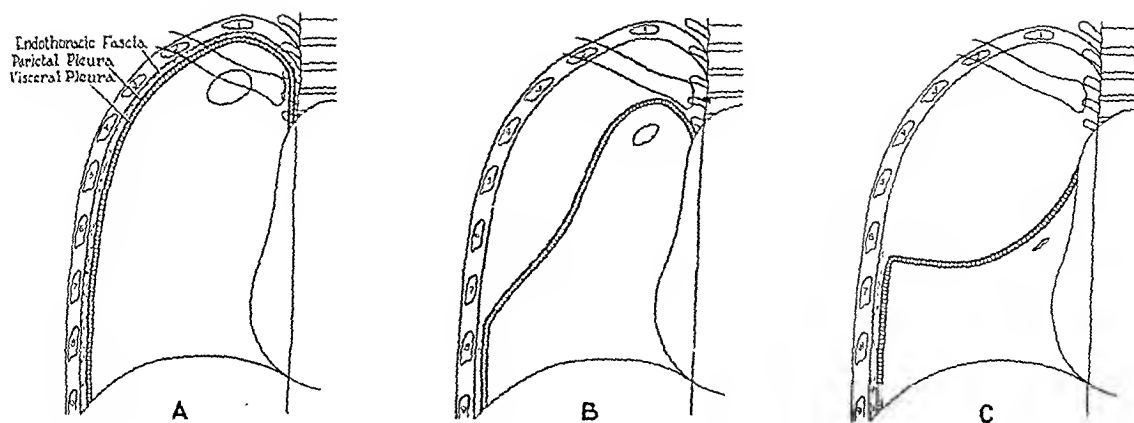


Fig. 1. Extrapleural pneumothorax: diagrammatic illustration of operation. A. Relation of adherent visceral and parietal pleura to the endothoracic fascia. B. Separation in the plane of the endothoracic fascia immediately following operation. C. The extrapleural space several weeks after operation.

fourth rib from the transverse process forward. The plane of the endothoracic fascia is usually easy to locate, and the loose connective-tissue fibers are broken with the finger, allowing the two adherent pleural surfaces and the lung to fall away from the bony thorax and the intercostal muscles. The extrapleural space is developed with the finger until a rib spreader can be introduced and the remainder of the dissection is carried out with gauze-padded instruments under direct vision with the aid of an illuminated retractor. Bleeding is controlled by packing and ligation with silver clips when necessary. It is absolutely essential to keep the line of dissection in the extrapleural space. If this cannot be done, because of dense adhesions and obliteration, the operation must be abandoned before rupture of the pleura takes place.

It is essential that the stripping be adequate at the time of operation, since it is unusual for the extrapleural pocket to be enlarged by air pressure in the following days; more commonly a portion of the pocket is lost in the first few weeks. Extrapleural pneumothorax can be made the most selective of all forms of collapse, but stripping should always be carried down to the hilus on the mediastinal surface and concentrically around the chest wall well below the diseased area. It is possible to strip down to the diaphragm and even from a portion of the diaphragm. When the stripping is completed, the entire

pocket is inspected for bleeding and the wound is closed airtight. During the entire operation 10 per cent glucose is given intravenously. Transfusion has been required in only one of our patients. We have been impressed with the lack of shock and the ability of the patient to recover from the procedure as compared with graded stages of thoracoplasty.

Postoperative Care and Management: We feel that the refills and management of the extrapleural space, especially during the first two weeks, determine the success or failure of the procedure. At the end of the operation, the patient is turned on his back and, while he is still on the operating table, a needle is placed in the first or second interspace anteriorly and the pressure brought slightly to the positive side, which usually requires from 150 to 200 c.c. of air. The patient is then moved to the fluoroscopic table and the size of the pocket is observed. Usually a film is made at this time for future reference.

The patient is then put to bed and is turned at three-hour intervals until he is able to turn himself. Small doses of morphine or codeine are usually required for two or three days for discomfort and to control coughing. It is not desirable to abolish the cough, but hard coughing may cause a thin-walled cavity to rupture and always increases the subcutaneous emphysema. Vomiting also increases the amount of air forced out into the tissues. Only those pa-

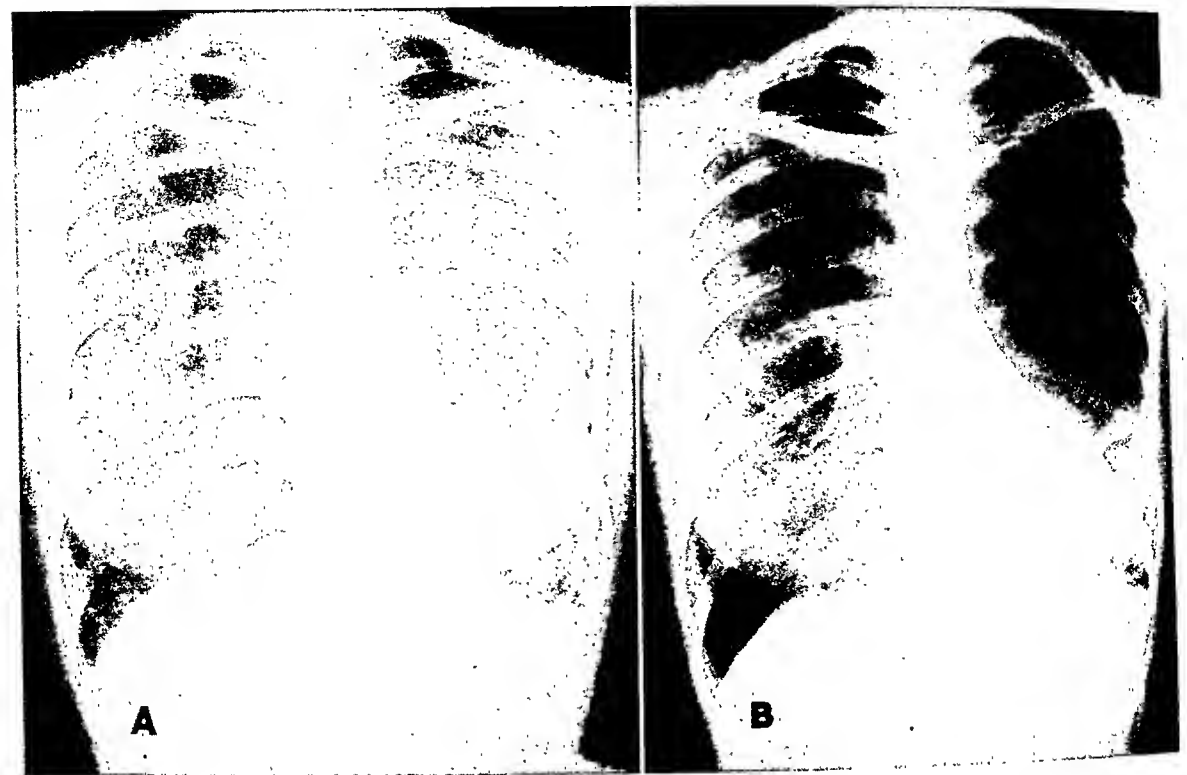


Fig. 2. A. Pneumothorax (right) with large cavity held open by adhesions. Cavity probably of tension variety. B. Same case after operation. Cavity closed; small intrapleural pneumothorax in base.

tients with very low vital capacity have required oxygen.

The patient is examined on the fluoroscopic table at five-hour intervals for the first thirty-six hours and refills are given at these times as often as necessary to maintain the space, the pressure being kept just on the positive side. After this interval, the space usually begins to hold air well, and for the remainder of the first week daily fluoroscopy and refills are sufficient, the lung being gradually collapsed by increasing the pressure. The intervals between fluoroscopy and refilling are then prolonged, a day at a time, as the case permits, usually to as much as a week, and the pressure is brought up to 20 to 30 mm. of water.

In all cases a serohemorrhagic exudate forms, partially filling the space, and this is usually aspirated on the fifth or sixth day, by which time the patient is in most instances able to stand up for fluoroscopy. In a few cases the exudate has been so slight that aspiration was not considered necessary. In other cases two or three as-

pirations have been required. If the space is not dry at the end of three or four weeks, infection, either tuberculous or pyogenic, should be suspected.

COMPLICATIONS AND RESULTS

Complications of extrapleural pneumothorax may be divided into immediate and late. The immediate complications may be listed as follows:

1. Rupture into cavities or pulmonary tissue. If this occurs, the operation should be immediately abandoned.
2. Hemorrhage. This should be controlled at the time of operation, and the wound should not be closed until the pocket is dry.
3. Shock. Shock should be treated as in any other operative procedure, first by preventing it.
4. Subcutaneous emphysema. This occurs in moderate degree in all cases if the patient coughs or vomits, but it is not alarming.

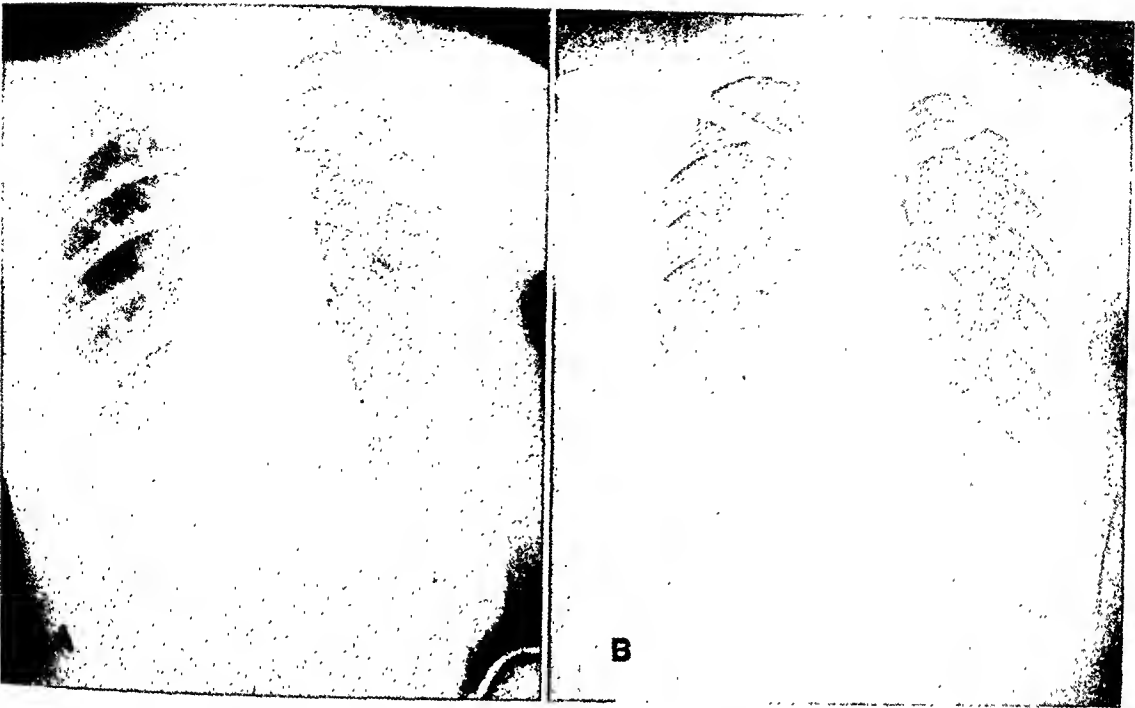


Fig. 3. A. Bilateral disease. Pleura adherent on the right, demonstrated by attempt to establish intrapleural pneumothorax. B. Extrapleural pneumothorax on the right; intrapleural pneumothorax on the left.

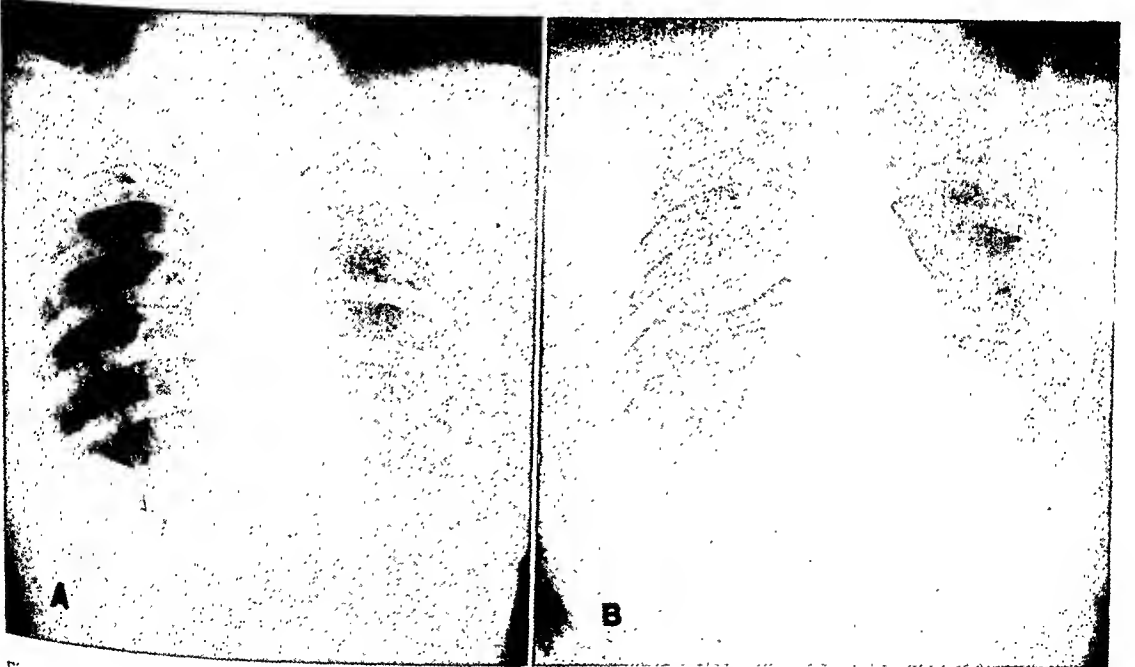


Fig. 4. A. Bilateral disease. Pleura adherent on both sides, demonstrated by attempted bilateral intrapleural pneumothorax. B. Bilateral extrapleural pneumothorax.

5. Rupture of cavities near the periphery, due to necrosis caused by destruction of blood supply. This can be prevented only by the proper selection of cases.
6. Wound infection, which is disastrous when it occurs.
7. Contralateral spread. The same steps should be taken as in thoracoplasty to prevent this.
8. Loss of extrapleural space. Careful postoperative management will prevent this.
9. Atelectasis of the lower lobe. The same measures should be taken as in thoracoplasty.

TABLE I: EXTRAPLEURAL PNEUMOTHORAX

Davidson County Tuberculosis Hospital, December 1938-June 1941 (2½ Years)

Number of patients.....	48
Number of lungs collapsed.....	51
Number of operations.....	52
Bilateral extrapleural, pneumothorax.....	3 patients
With contralateral intrapleural, pneumothorax.....	13 patients
Combined intra- and extrapleural, with division of septum.....	2 patients
Basal extrapleural.....	1 patient
Successful operations (46 on 42 patients).....	88.4%
No complications (34 operations, 32 patients).....	64.4%
Conversion of sputum (in 35 patients).....	75.0%
Operative mortality.....	0.0%
Late mortality (4 patients).....	8.3%

TABLE II: COMPLICATIONS OF EXTRAPLEURAL PNEUMOTHORAX IN SERIES OF 48 PATIENTS

Immediate operative complications in 6 patients	
Inability to establish sufficient space.....	1
Pulmonary tissue known to be entered at operation.....	3
Breaking down of wound (pyogenic).....	2
Late complications in 11 patients	
Extrapleural bronchial fistula.....	4
Tuberculous empyema without fistula.....	7
Contralateral spread.....	1
Late deaths, 4 patients	
Cardiac.....	1
Progressive disease and bronchial fistula.....	1
Respiratory infection with low vital capacity....	1
Wound infection and progressive disease.....	1

The late complications are: empyema (tuberculous and mixed), bronchial fistula, and loss of extrapleural space.

The accompanying figures and tables show the complications and results in a

TABLE III: RESULTS OF EXTRAPLEURAL PNEUMOTHORAX: THREE- TO FIVE-YEAR REVIEW OF 48 PATIENTS

Disease under control (sputum negative)	
27 patients.....	56.2%
Disease still active or complications in space	
10 patients.....	20.8%
Dead	
11 patients.....	22.9%
Expansion being tried in 9 patients; space not completely obliterated in any to date.	

series of cases at the Davidson County Tuberculosis Hospital from December 1938 to June 1941.

CONCLUSIONS

1. The indications for extrapleural pneumothorax are not definitely established, and it should be reserved for those patients in whom proved procedures cannot be used.

2. It offers a selective and effective collapse of the diseased portion of the lung and can be maintained over a sufficient period of time to allow healing.

3. Technically, it is a difficult procedure, and when complications occur they are more serious than in other forms of collapse.

4. The success of extrapleural pneumothorax is determined by securing adequate extrapleural space at the time of operation and careful postoperative management to maintain this space and prevent complications.

5. Complete expansion of the lung with obliteration of the space is unlikely, and thoracoplasty is now indicated in most of these patients.

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DISCUSSION

C. C. Birkelo, M.D. (Detroit, Mich.): I want to compliment Dr. Alley on the excellent results which he obtained by extrapleural pneumothorax. Just before coming here, I looked up our results from this method of treatment and found that they were very poor. I believe the reason for this is that we use this method only as a last resort. We prefer thoracoplasty when this is possible, or cavernostomy for basal cavities.

The So-Called Retarded or Occult Fractures

Significance of the Parallel Projection in the Roentgen Diagnosis of Fractures¹

BENEDICT J. TOTH, M.D.

Olean, N. Y.

ON OCT. 14, 1941, a 27-year-old truck driver was referred for roentgenographic examination of his right hip and knee, with the following history. In the early afternoon of Oct. 14, as he was climbing on the tailgate of his truck, it slipped and he was thrown to the pavement, landing on his right hip and right shoulder. He did not become unconscious but experienced severe pain. He got up and drove his truck a short distance, but the pain soon became unbearable, and he was brought to the hospital.

nation in the oblique projection showed no evidence of a fracture." The patient continued, however, to complain of severe pain in the right hip region for about ten days following injury. Gradually the pain subsided, although it did not disappear completely. The patient was discharged from the hospital on Oct. 31, seventeen days after the accident.

Because of continued complaints of pain in the right hip region, especially on certain movements,

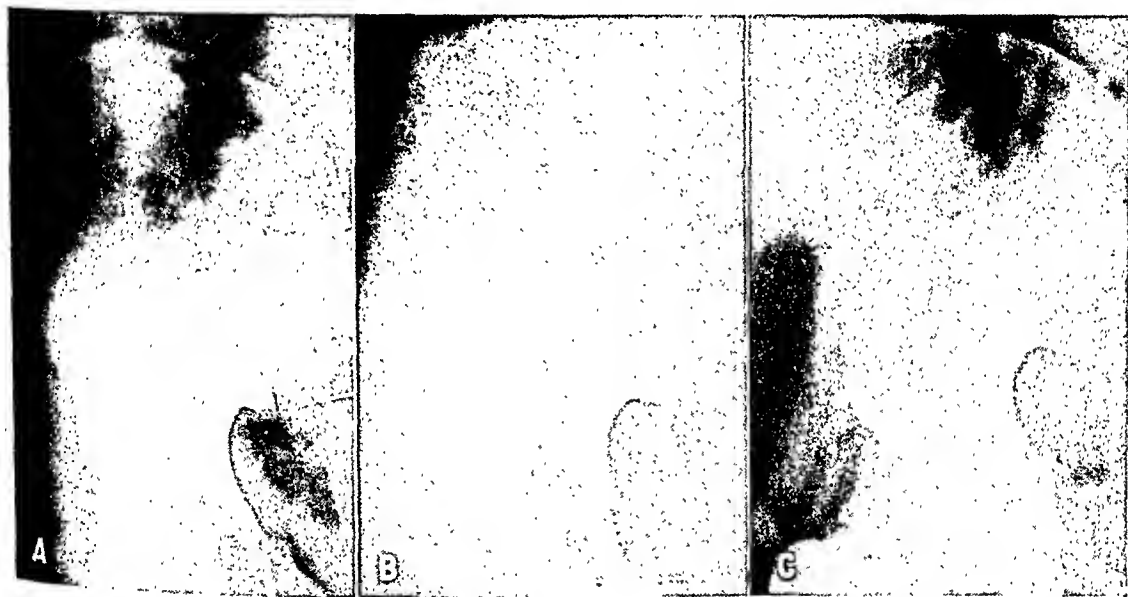


Fig. 1. A. Roentgenogram of pelvis, anteroposterior view, taken Oct. 14, 1941. B. Oblique view, taken Oct. 21, 1941. No definite fracture line is seen in either view. C. Anteroposterior roentgenogram of pelvis, Nov. 19, 1941. Note the large fracture gap with callus at the caudad end. There was no history of a second injury.

Physical examination revealed extreme tenderness on palpation and some excoriation just above the region of the greater femoral trochanter. The clinician's impression was that "most of the tenderness seemed to be in the muscle." The roentgen examination of the pelvis on the day of the injury was reported as follows: "There is no definite evidence of a fracture. To exclude, however, the possibility of some fissure fracture of the right innominate bone in its lateral portion, in view of the suggestive physical findings, an examination of the right hip in the oblique positions would be advisable."

On Oct. 21, a week later, a "radiographic exami-

the pelvis was radiographed again—in the anteroposterior position only—on Nov. 19, 1941, five weeks after the initial trauma. A huge fracture of the right innominate bone was discovered. There was no history of any injury in the period between the patient's fall on Oct. 14 and this last x-ray examination.

A careful restudy of the initial roentgenograms still failed to reveal any definite fracture line in the region of the large fissure fracture demonstrable five weeks later (Fig. 1).

After the experience of this unusual case, it became more or less our routine

¹ From the Departments of Radiology, St. Francis Hospital, Olean, N. Y., and City Hospital, Salamanca, N. Y. Read by title at the Joint Meeting of the American Roentgen Ray Society and the Radiological Society of North America, Chicago, Ill., Sept. 24-29, 1944.



Fig. 2A. Anteroposterior and oblique roentgenograms (with magnifications below) made Feb. 20, 1943.
No fracture is seen.

procedure to examine certain suspicious cases three or four weeks after injury. Since, as is well known, ribs are among the most difficult bones for fracture visualization, most of these repeated roentgenograms were requested in cases in which costal fractures were suspected. Displacement of fragments and a rather wide fracture gap

without noticeable displacement or callus were the positive radiographic signs of fracture in these late examinations. Routine- anteroposterior or postero-anterior and lateral views (in rib cases anteroposterior or postero-anterior and one oblique exposure with the injured part close to the film) were usually employed (Figs. 2 and

3). Some cases came to our attention, however, where re-examination with the usual standard views failed to reveal the fracture and additional views were required (Figs. 4-6).

HISTORICAL

The literature of the last twenty years has been reviewed. That of the preceding years was not covered in view of the probably less adequate roentgen ray technic. Melnikowa, in 1929, discussed among other problems the question of invisible fractures, reporting 3 cases in which x-ray films taken immediately after injury failed to show any fracture. A few weeks later, however, fractures were clearly demonstrable in films taken "with the parts in the same position as before." The bones involved were the diaphysis of the ulna, shaft of a metacarpal, and shaft of a metatarsal. Melnikowa quotes Kimmerle, who in 1927 reported similar findings in the case of a fractured navicular and ribs. Lindeman, who had a similar experience with a fractured femoral neck, is also mentioned. Melnikowa, assuming that both exposures were technically without error, suggested two possible explanations for the difference between the two studies: (1) that the views were not exactly identical; (2) that lack of immobilization, resulting in frequent movements of the fragments, had probably caused pronounced hyperemia and absorption of the bony trabeculae at the fracture surfaces, thus resulting in a wider and sharper fracture line. Kimmerle held the second of these explanations as the more likely. The value of repeated roentgen examinations in suspected but "negative" cases was stressed by all these authors.

Jordan-Narath, in 1932, discussing fractures which are most frequently missed, mentioned *too early x-ray study* as one of the errors. According to him, infractions are frequently visualized for the first time only fourteen days after the injury.

Masmonteil, in 1935, in an article "*Fractures à retardement ou fractures avec déplacement en deux temps*," emphasized

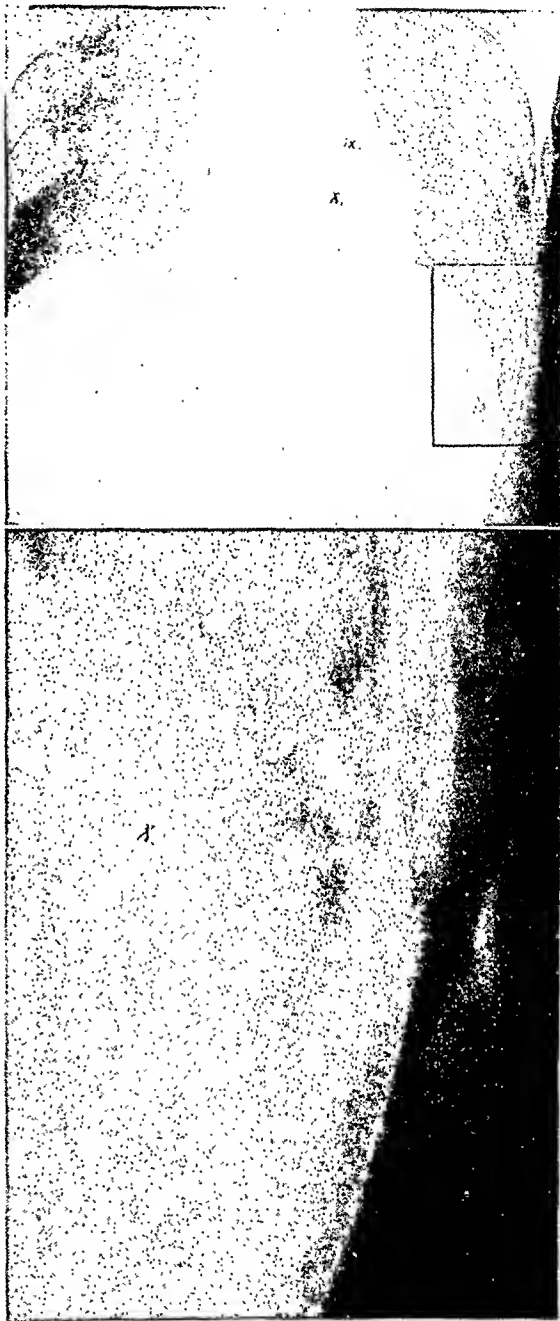


Fig. 2B. Anteroposterior roentgenogram (same case as Fig. 2A) March 6, 1943. The displacement of the fragments of the left 9th rib is several millimeters. A fracture of the left 10th rib with slight displacement of the fragments is also noted.

the scientific as well as the medicolegal value of a second x-ray examination about two weeks following the initial study. In one of the two cases which he describes, the original roentgen examination of the right hip, in two projections, showed no evidence of a bone lesion. Thirteen days later, be-

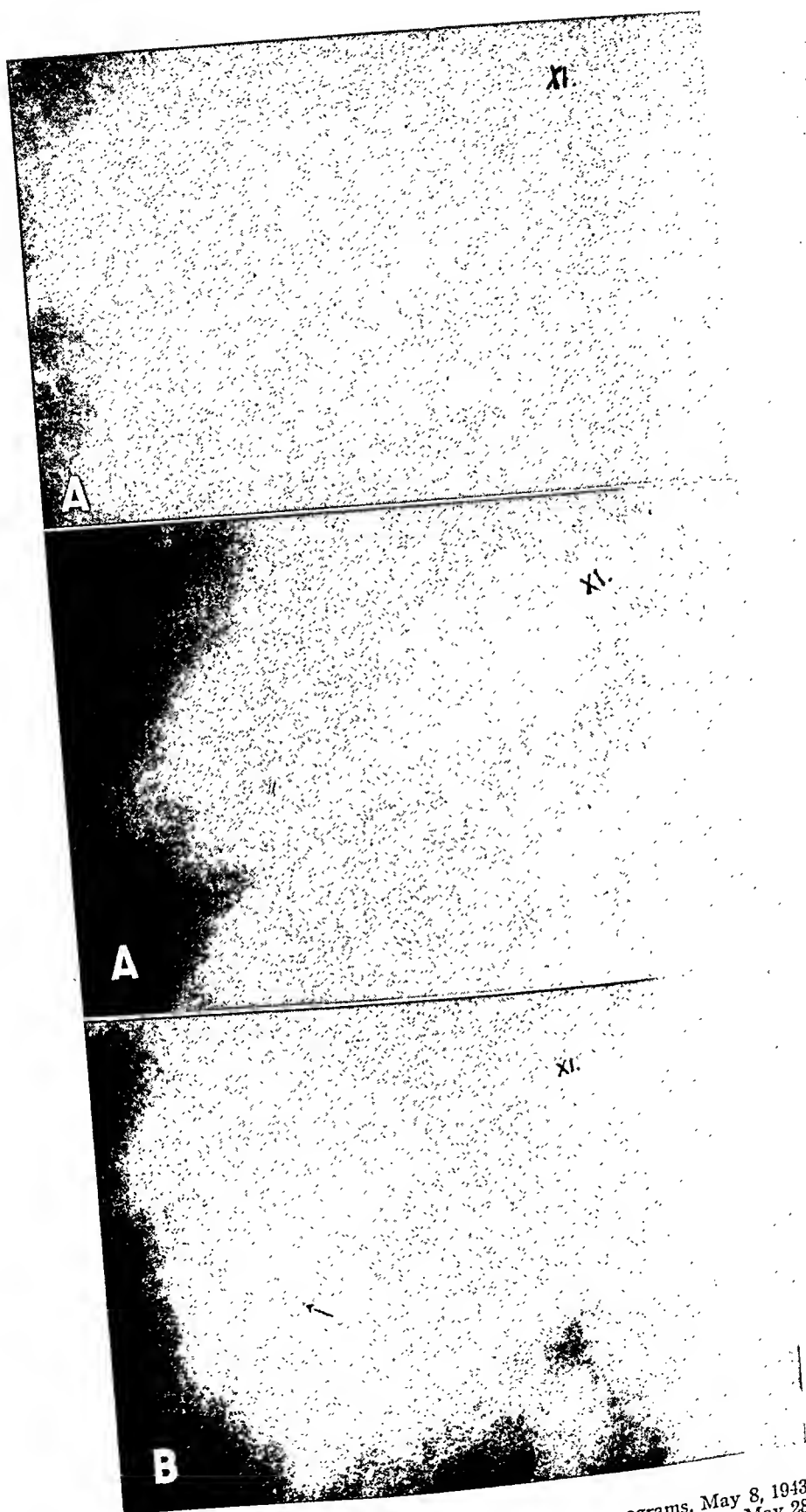


Fig. 3. A. Anteroposterior and oblique roentgenograms, May 8, 1943. No definite fracture is seen. B. Anteroposterior roentgenogram, May 28, 1943. The fracture gap of the right 11th rib is indicated by the arrow.

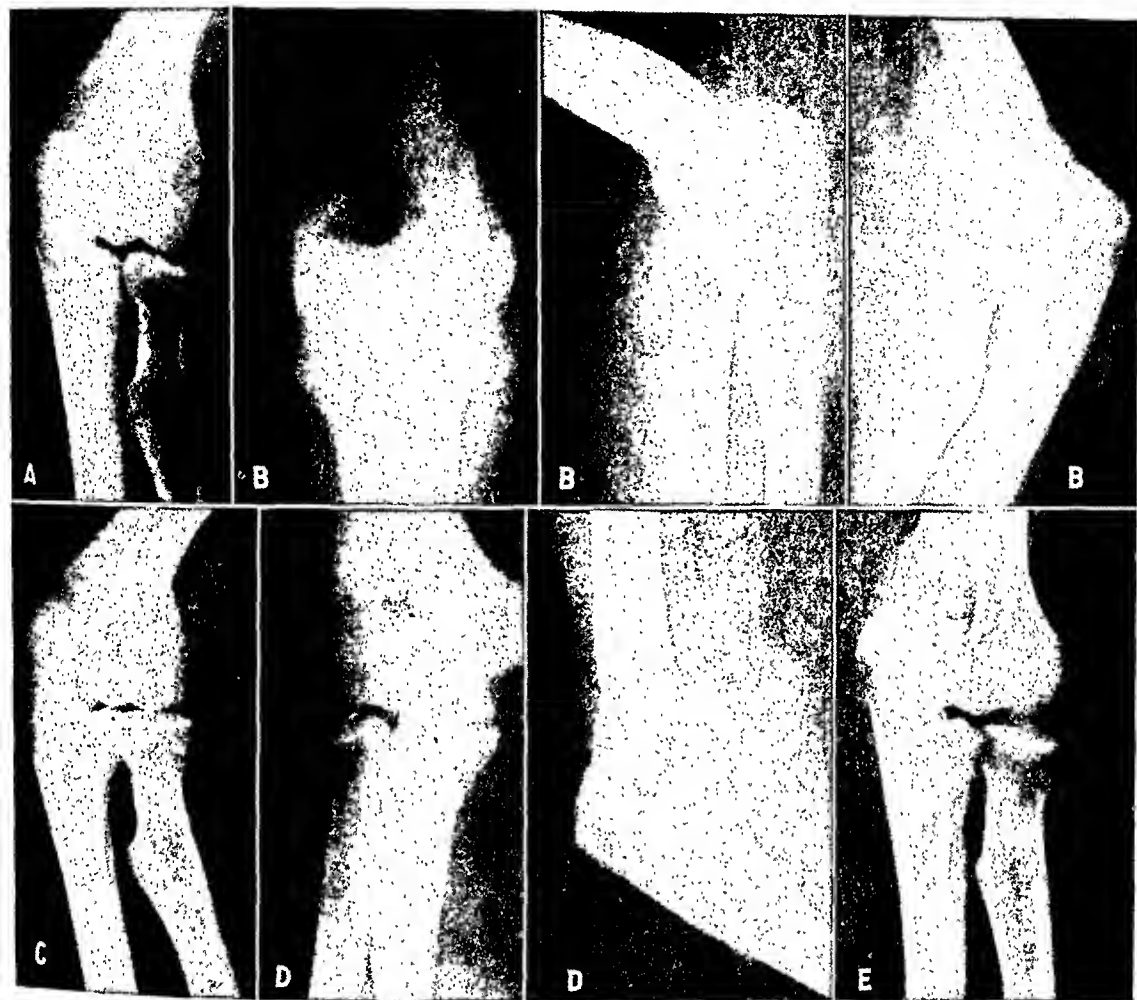


Fig. 4. A. Fracture of the left radial head, quite clearly visible in the anteroposterior ulnoradial oblique, fracture-parallel projection, although this view is technically poor, with a blurred image. B. The other three views (anteroposterior, lateral, and slightly oblique) fail to demonstrate the fracture. (For the anteroposterior view the patient was unable to extend the forearm.) C. Practically the same view as A, without motion, showing the fracture gap distinctly. D. Anteroposterior and lateral projections, taken four months after the initial study, revealing no definite evidence of fracture. E. Parallel view, taken on the same day as D, still shows the fracture with some displacement of the fragments.

cause of the spontaneous aggravation of pain, a second x-ray examination was done, which revealed a fracture of the femoral neck with displacement of the fragments. In the other case, a clavicular fracture was detected ten days following the initial radiographic examination. According to Masmonteil, these cases pass through two stages: (1) a *traumatic stage*, with rupture of the osseous trabeculae, followed by thrombosis of the haversian vessels and consequent aseptic necrosis of the osseous segments; (2) a *reactionary stage*, in which the polymorphonuclears and macrophages enter into action, resorbing the dead cells together with the altered red corpuscles,

while the osseous substance begins to absorb through diastasis. This entire process is directed through the influence of the sympathetic nervous system, which regulates the actions of the vasomotors. The result is a progressive weakening of the haversian framework, which now easily gives in to the influence of muscular contractions. Thus on the tenth to the twentieth day the fracture will be revealed, with displacement.

Nau dealt with this subject in 1935 and 1936. He described three different signs of fracture demonstrable in the late roentgenograms: (1) formation of callus, (2) sudden or progressive displacement of

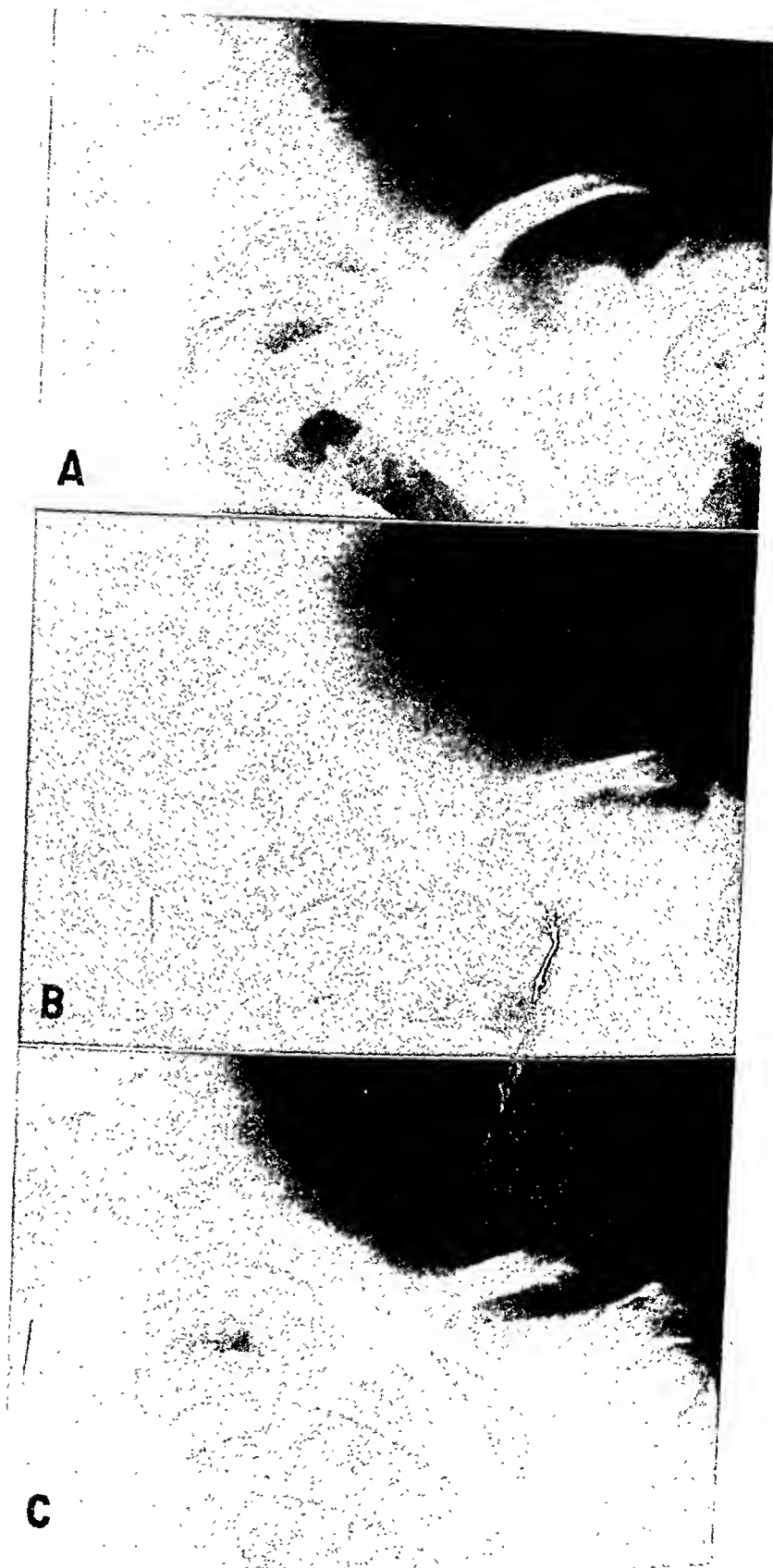


Fig. 5 A. Anteroposterior view of left clavicle. No fracture is seen. B. Postero-anterior view, taken at the same time, revealing a definite fracture. Note the difference in the two projections. C. Anteroposterior view two weeks later. The only evidence of fracture is some callus.

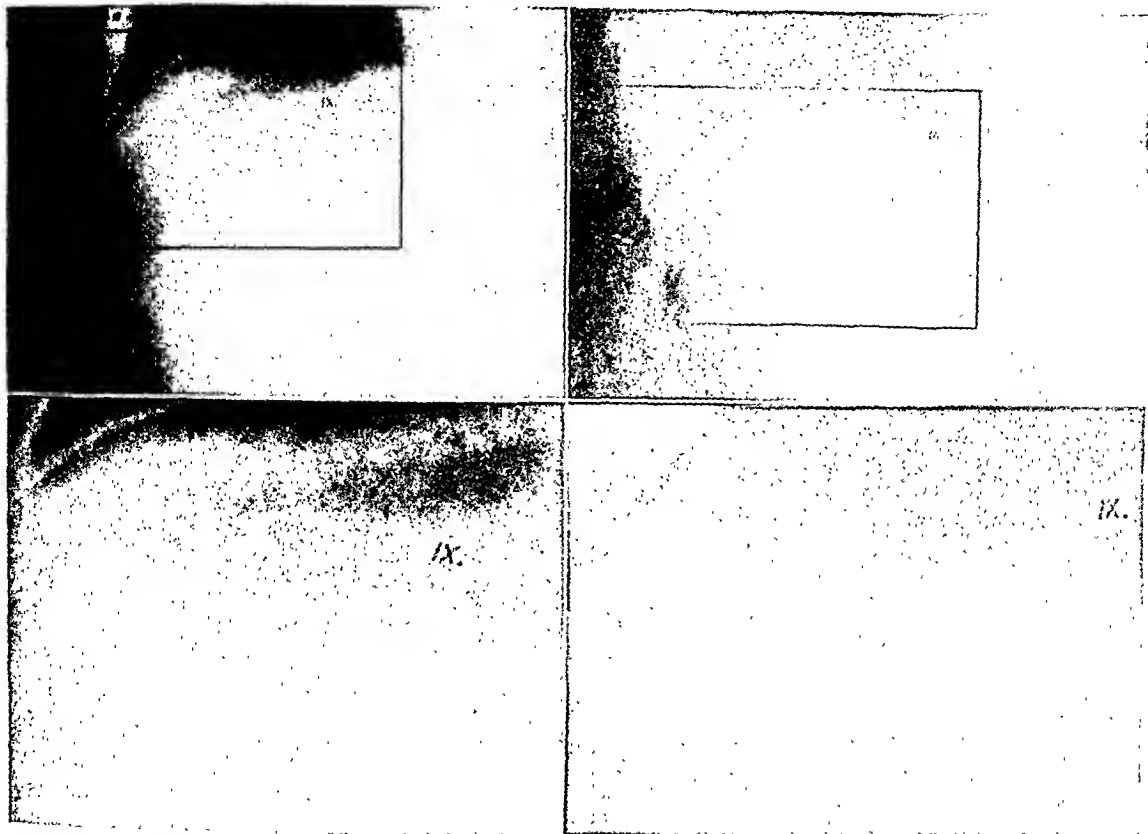


Fig. 6A. Anteroposterior and oblique views (with magnifications below) of ribs fifteen days after injury and two weeks after initial roentgenograms, showing a fracture of the right 8th rib with fairly wide gap. No fracture of the 9th rib is seen.



Fig. 6B. Opposite oblique exposure in case shown in Fig. 6A, taken on the day of the first x-ray examination, reveals a fracture of the right 8th and 9th rib, demonstrating the occasional superiority of individual initial study over "routine" re-examination.

time for re-examination. His studies included fractures of the ribs, toe, fibula, and scapula.

In 1941, Hammond and O'Connor presented their paper on "occult fractures" at the annual meeting of the American Medical Association. These authors believed that such fractures are not rare and that they are evidently missed in large numbers. They stressed the importance of the clinical examination in suspected fracture cases and concluded that in cases of doubt the physical examination should prevail. Other authors of recent years (Lachmann, Cohn) have also emphasized the great importance of the physical examination, apparently after repeated disappointments in the "verdicts" of the x-ray examinations.

PARALLELISM OF THE X-RAY BEAM AND THE FRACTURE

For the roentgen diagnosis of fractures the following signs are usually necessary:

the fragments, (3) appearance of a fracture gap through the calcareous resorption at the surfaces of the fragments. He considered six to eight weeks the optimum



Fig. 7. A. Anteroposterior and lateral views of right ankle, taken June 17, 1944, revealing a fairly definite fracture of the tibial end on the posteromedial aspect. B. Anteroposterior and lateral views, taken Aug. 8, 1944. These would easily be diagnosed as negative. C. Anteroposterior fibulotibial oblique projection (practically parallel with fracture gap) taken Aug. 8, 1944, showing distinctly a large fissure. Similar views on the first examination also revealed the fracture.

(1) fracture gap, (2) displacement, (3) change in the cancellous structure, such as the "folding" of torus fractures, the dense line of impacted fractures, etc., (4) signs of healing, (5) indirect signs, such as veiling of accessory nasal sinuses, etc., which, however, are not specific.

Our discussion is concerned chiefly with the *fracture gap*, and to some extent with *slight displacements*. According to Lachmann, apart from technical factors, such as poor equipment, motion, etc., the roentgen invisibility of fractures is due to the minute size of the fracture gap or to an

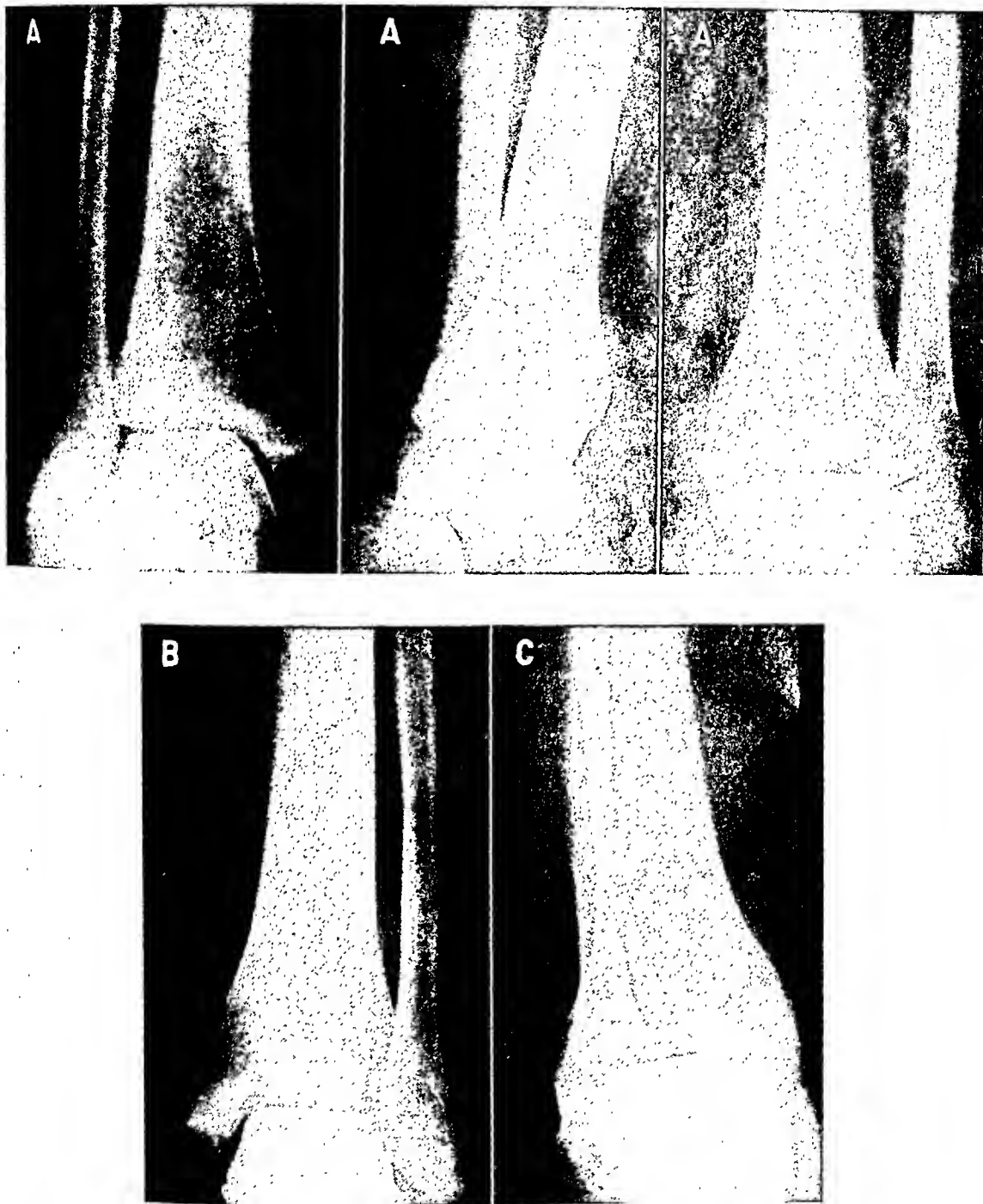


Fig. 8. A. Anteroposterior fibulotibial, lateral, and postero-anterior tibiofibular oblique views of the left ankle fail to reveal any evidence of a fracture. B. Anteroposterior view showing a short, faintly visualized fissure; the x-ray beam here approached parallelism with part of the gap. C. Anteroposterior tibiofibular oblique projection. This is practically parallel with the long fissure fracture, which is properly visualized.

insufficient number or wrong choice of projections. He agrees with Hunsberger that linear fractures can usually be demonstrated only if the x-rays traverse the bone

in the direction of the fracture line. Hill, discussing Hammond and O'Connor's paper, mentions the following principles for fracture visualization: (1) a roentgen-ray

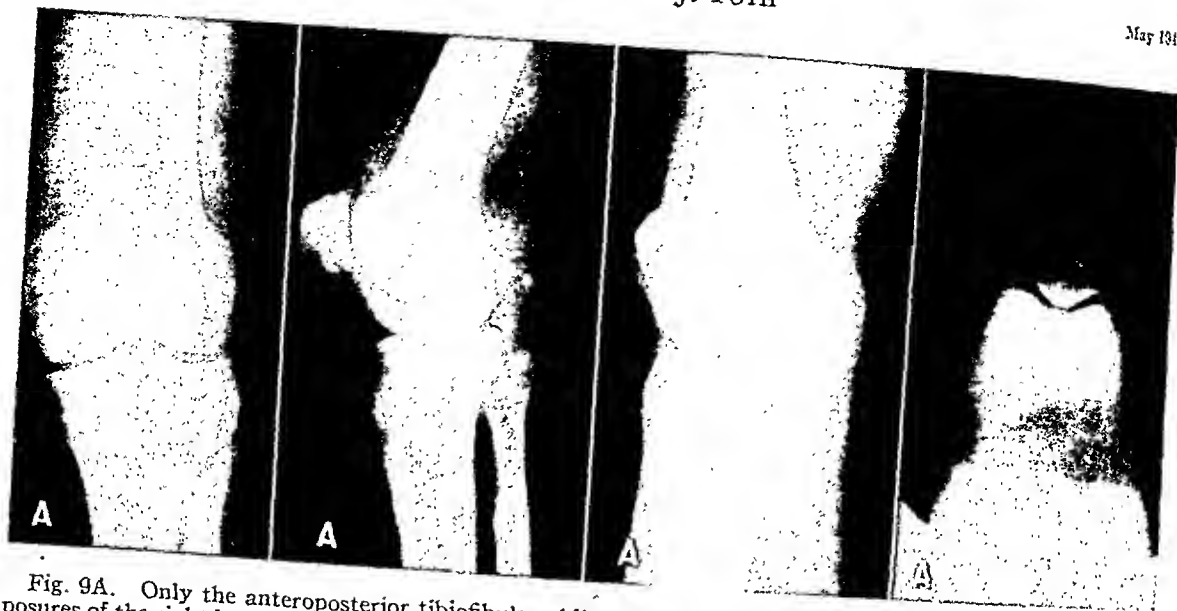


Fig. 9A. Only the anteroposterior tibiofibular oblique, fracture-parallel view (third from left) of the four exposures of the right knee reveals definitely the fracture gap in the patella. Note the small scale-like chip fragment at the posterior aspect of the knee joint in the lateral view (arrow). Sometimes this alone is suggestive of occasionally extensive osteochondral fracture of the patella (Milgram).

tube of the finest focal spot obtainable, (2) non-screen film technic whenever possible, or fine detail intensifying screens where screens are required, (3) proper density of roentgenograms, (4) immobilization of the patient, (5) extra views in cases in which experience has indicated that fractures are commonly overlooked, (6) careful clinical examination by the radiologist before the patient is dismissed as negative, to make sure that all possible variations in positioning and technic have been employed for the case being examined. Pease suggests at least six different views of the wrist for a proper study of a questionable scaphoid fracture.

Of all these technical factors, we wish to emphasize the great importance of an exposure with the x-ray beam parallel or nearly parallel with the fracture line (Figs. 4, 7, 8, 9, 10). In the presence of all the important technical factors mentioned above, the fracture may still be invisible if the x-rays do not traverse the bone in the direction of the gap. On the other hand, if a parallel projection is obtained, films of comparatively poor quality will frequently reveal the fracture (Fig. 4, A). We have found, in accordance with Lachmann, Lewis, Garland, and others, that stereoscopic views in one projection are usually

not satisfactory substitutes for projections from different angles.

The importance of the parallel projection is also evident in cases of slight displacement, where the tangential view, in which the x-ray beam is actually parallel with the protruding fragment, is necessary for the proper demonstration of the fracture (Figs. 5 and 7). It is questionable whether the fracture visualization in certain cases reported by Nau was entirely due to a "sudden displacement" of the fragments. The different angle of the incident x-rays, resulting in a parallel or tangential projection, is probably more often responsible for the appearance of the fracture than an actual "sudden displacement" (Fig. 5).

COMPARATIVE VALUE OF THE INITIAL ROENTGEN STUDY AND THE ROUTINE RE-EXAMINATION

It is well known to all radiologists that there are certain bones which, either because of their position or because of their anatomical configuration, usually present difficulties in the diagnosis of fractures. Such bones include, among others, the clavicle, ribs, scapula, humeral head, head of the radius, carpal scaphoid, metacarpals, innominate, femoral neck, ends of the tibia, and metatarsals. It is these structures es-

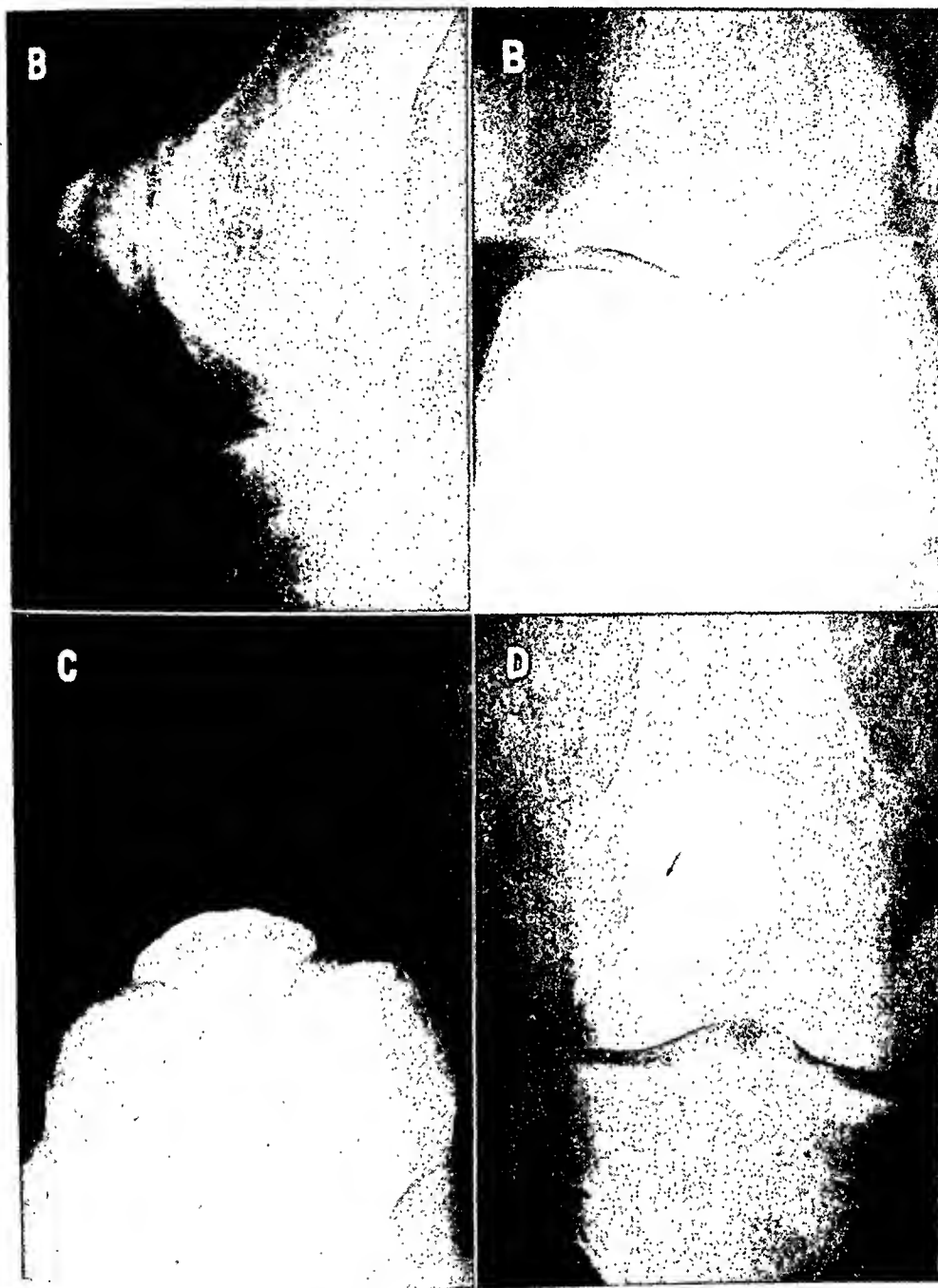


Fig. 9 B-D. B. Lateral and tangential views of case shown in Fig. 9A, taken about five weeks later, still revealing no evidence of a fracture. C. One of the tangential views on this re-examination shows the fracture, apparently due rather to an incidental change in position, giving a more nearly parallel projection, than to reparative changes of a true retarded fracture, since other tangential views failed to demonstrate the gap. Note the positional difference between the tangential views. D. An overexposure in the re-examination also shows the fracture line, which is evidently closely parallel with the incident x-ray beam. C and D would have been easily classified as "occult fractures."

pecially which need careful individual consideration. (The skull and spine are not included in our present study.)

In view of the prerequisite of a parallel

projection for proper x-ray visualization in "negative" fracture cases, two exposures, preferably opposite oblique, should be added to the ordinary anteroposterior or

TABLE I: REACTIONS TO CHOLECYSTOGRAPHIC MEDIA: PRESENT SERIES COMPARED WITH OTHERS IN THE LITERATURE

Author, Dye, and Number of Cases	None	Nausea		Vomiting	Diarrhea			Burning Urination	Miscellaneous
		Mild	Severe		Mild	Moderate	Severe		
Wasch (10) Priodax: 134 cases	43 (32%)	23 (17.6%)	2 (0.8%)	0 0	17 (12.6%)	..	1 (0.7%)	27 (20%)	Epigastric pain, 9 Headaches and dizziness, 5
Daumenberg (8) Priodax: 143 cases	9 (6.3%)	7 (4.9%)	17 (12%)	3 (2.1%)	3 (2.1%)	30 (20.9%)		24 (16.8%)	
Oelsner (12) Priodax: 300 cases	169 (56%)	52 (17.3%)	18 (6%)	8 (2.7%)	..	..		16 (5%)	Abdominal pain, 28 (9%)
Hefke (13) Priodax: 600 cases	...	48 (8%)		5 (0.08%)	48 (8%)	18 (3%)	..	3 (3% of 100 males)	....
Paul, Pohle, and Benson (5) Priodax: 114 cases	...	32 (28.1%)		2 (1.7%)	13 (11.4%)	6 (5.3%)	7 (6.1%)	17 (15%)	....
Tetraiodophenolphthalein: 80 cases	...	36 (45%)		4 (5%)	11 (13.7%)	4 (5%)	8 (10%)	..	....
Present series Priodax: 50 cases	19 (38%)	15 (30%)	1 (2%)	1 (2%)	8 (16%)	6 (12%)	4 (8%)	24	Epigastric pain, 2 Slight headache, 2 Slight dizziness, 1 Severe headache, 2 Severe sneezing, 1
Tetraiodophenolphthalein: 50 cases	12 (24%)	12 (24%)	22 (44%)	4 (8%)	11 (22%)	7 (14%)	7 (14%)	2 (4%)	

Priodax, using cats as the experimental animal. The work of these investigators has been reported, and their results quoted, by several authors, and need not be considered at length here. Their conclusions warrant the assumption that Priodax is sufficiently non-toxic in the dosages used for cholecystography that it may be considered a safe drug.

Junkmann's (3) work suggests that the main advantages of the new preparation rest on the fact that most of it is eliminated in the urine (more than 50 per cent in the first twenty-four hours), while very little tetraiodophenolphthalein is thus excreted; most of the latter is eliminated by way of the intestinal tract, thus causing more gastro-intestinal symptoms. In addition, Junkmann (3) found the iodine content of the bile to be much greater after administration of Biliselectan (Priodax) than after the administration of tetraiodophenolphthalein.

In the present series of cases, the two drugs were alternated between patients because we believed a more direct comparison of the side effects could be made in this way. One's ideas of degree in evaluating severity of symptoms is prone to change or be influenced by anticipated results unless kept in balance by a continuous control. By constantly checking one drug against the other, such a balance, in my opinion, is best obtained.

Of the 100 patients, 53 were referred from the Outpatient Clinic and 47 were hospital cases. All had symptoms sufficient to warrant a request for cholecystographic examination.

The same routine was followed in all cases. A lunch of moderately high fat content was given at noon. A fat-free evening meal was given, followed in one hour by administration of the contrast substance to be used, either 3.5 gm. of tetraiodophenolphthalein or 3.0 gm. of Priodax. The tetraiodophenolphthalein was given dissolved in water. Priodax was given in six 0.5 gm. tablets to be swallowed with water at five-minute intervals. After this, nothing was permitted by mouth except

water until the roentgen examination the next morning. Films were made at fourteen and sixteen hours. The single-dose method was used throughout.

The side reactions in this series of patients are listed in Table I. In addition, all investigations reported in the literature and considered of any value for comparison with the present series are listed. Some minor variations occur in the classification of the side reactions, but most reports coincide roughly with the classification used by Paul, Pohle, and Benson (5). We have followed this latter classification for the sake of uniformity, simplicity, and clarity, adding a column for those cases without side reactions and omitting "burning throat," which proved to be an insignificant occurrence in our series. Because of the reactions in our normal group, referred to later, the degree of nausea was considered of significance; hence this symptom has been classified as mild and severe. Except for these changes, a direct comparison can be made with the series reported by Paul, Pohle, and Benson (5).

After taking Priodax, 19 patients (38 per cent) reported no side reactions, while 12 patients (24 per cent) had no side reactions with tetraiodophenolphthalein. Nausea occurred in 16 (32 per cent) of the Priodax cases and in 34 (68 per cent) of those receiving tetraiodophenolphthalein. In addition, only one patient (2 per cent) reported severe nausea with Priodax, but 22 (44 per cent) had severe nausea with tetraiodophenolphthalein. Vomiting occurred rarely with either drug: once (2 per cent) with Priodax and 4 times (8 per cent) with tetraiodophenolphthalein. Diarrhea was present in 18 (36 per cent) of the Priodax cases and in 25 (50 per cent) tetraiodophenolphthalein cases—possibly not a significant difference in such a small series—nor was there any striking difference in the various degrees of diarrhea.

Burning on urination with the first morning voiding was reported by 24 (48 per cent) of those receiving Priodax and, strangely, 2 (4 per cent) reported a similar symptom with tetraiodophenolphthalein.

TABLE II: REACTIONS IN 15 PATIENTS GIVEN BOTH PRIODAX AND TETRAIODOPHENOLPHTHALEIN

Dye	None	Nausea		Vomit- ing	Diarrhea				Burn- ing Uri- nation	Miscellaneous
		Mild	Severe		Mild	Moder- ate	Severe	Total		
Priodax	4	4	1	1	3	1	1	4	5	Headache, 1 Pain in epigas- trium, 2 Burning in epigas- trium, 1
Tetraiodophenol- phthalein	3	5	6	1	4	2	4	9	0	....

The former can be accounted for by the large amount of the drug excreted in the urine during the first twenty-four hours, but an insignificant quantity of tetraiodo-phenolphthalein is supposed to be thus eliminated. Miscellaneous symptoms were so mild and occurred so infrequently that they require only brief mention. With Priodax, 2 patients complained of mild epigastric distress, 2 had mild headaches, and 1 slight dizziness. With tetraiodo-phenolphthalein, 2 patients complained of severe headaches and 1 had a spell of violent sneezing.

In this series, several studies were repeated when no shadow or a poor shadow was obtained at the first examination. In almost all instances, Priodax was given at the second examination because, as our figures show, more failures occurred after tetraiodophenolphthalein and because it was difficult to get staff physicians to refer patients back for a second examination if tetraiodophenolphthalein was the dye to be used. The same difficulty was not encountered when the reverse was true. This fact in itself appears significant.

In fact, near the end of our series some difficulty was encountered because the staff physicians began to request that Priodax be given or that we arrange their patients in the series so that they would receive Priodax. These requests were ignored, with one or two exceptions. This observation has made a strong impression on me, for the radiologist, in spite of his desires to the contrary, does not have the close contact with, and continued observation of, his patients that is the privilege of the clinician.

Table II presents the side reactions in 15 patients who received both dyes. At least five days elapsed between examinations to preclude the possibility of a cumulative effect. As mentioned previously, Priodax was the second drug in almost all instances. A study of the table reveals that the chief differences were in the incidence of nausea and diarrhea and the severity of these symptoms. With Priodax, 5 patients complained of nausea, but in only one instance was it severe; but with tetraiodophenolphthalein, 11 patients had nausea and in 6 it was severe. The diarrhea was severe in only one of 4 patients complaining of this symptom after Priodax, while 4 of 9 patients had severe diarrhea after tetraiodophenolphthalein. In 3 cases there was moderate epigastric distress or burning and one patient had a mild headache after taking Priodax. There were no similar complaints with tetraiodophenolphthalein.

In addition to the series of 100 patients, 10 volunteers were given both preparations at least five days apart. In these cases, 5 were given tetraiodophenolphthalein first and 5 received Priodax first. These were so-called normals, or persons without clinical evidence of gallbladder disease. They were x-ray technicians, nurses, interns, and one stenographer. Seven were females and 3 were males.

The side reactions in these 10 persons are listed in Table III. It is significant that 6 of the 10 had no symptoms after taking Priodax, while only 2 were free from symptoms with tetraiodophenolphthalein. None complained of nausea with Priodax, but 8 had this symptom after tetraiodophenolphthalein and in 7 it was severe. For this

TABLE III: REACTIONS IN 10 NORMAL SUBJECTS RECEIVING BOTH PRIODAX AND TETRAIODOPHENOLPHTHALEIN

Dye	None	Nausea		Vomit- ing	Diarrhea				Burn- ing Uri- nation	Miscellaneous
		Mild	Severe		Mild	Moder- ate	Severe	Total		
Priodax	6	0	0	0	1	0	2	3	1	None
Tetraiodophenol- phthalein	2	1	7	1	2	0	2	4	0	Pain in abdomen, 1

reason, nausea is considered of major importance and is subdivided into mild and severe, as mentioned previously. In respect to other symptoms there was no great variation between the two drugs. After completion of both examinations each subject was asked the question, "If you had to submit again to an x-ray examination of the gallbladder, which preparation would you prefer?" The reply of all was, "Priodax." The reason in most cases is obvious, but those with mild or no reactions preferred the Priodax because of the ease of taking it; all complained of the "sickening taste" of tetraiodophenolphthalein.

From Tables I, II, and III, the most significant observation is the fact that nausea of severe form occurred much more frequently with tetraiodophenolphthalein than with Priodax, in our investigation. Since severe nausea is a very distressing symptom, any procedure that will decrease its incidence is worth while. There is no great disparity between our figures and those of Paul, Pohle, and Benson (5), but they minimize the importance of nausea and fail to evaluate the degree. Vomiting occurred in an insignificant number of cases with either drug, and this is in agreement with reports of others. Diarrhea occurred more frequently in our series than in any others in the literature, and was so common with both drugs that neither can claim a great superiority. This is contrary to the conclusions reached by Junkmann (3) but was suggested by the work of Modell (4). We also observed a greater number of patients complaining of burning on urination, but none of the patients attached any importance to this symptom, and its presence had to be elicited by leading questions.

The density of the shadows in our series of 100 cases is shown in Table IV, and our

results are compared with those of others. The value of a comparison of this kind is dubious unless one knows the type of patients referred for examination. This is forcefully illustrated by the figures of Kleiber and Rating, as given in Table IV. Kleiber (6) reports 45.6 per cent of 55 patients showing no shadow, while Rating (7) reports 94.8 per cent of 96 cases showing good shadows after Biliselectan (Priodax). Yet both stress the advantages of this medium. It is obvious that the number of patients with disease of the biliary tract in any given series will materially affect the proportion of good shadows. However, a comparison of the shadow densities obtained from the two dyes in a series of patients referred by the same clinicians is of value. This is especially true when supported by evidence obtained from a series of 15 patients and 10 normal persons given both dyes.

In the present series of 100 patients, 8 (16 per cent) showed no shadow after Priodax, but in 19 (38 per cent) of the tetraiodophenolphthalein cases no shadow was obtained. Poor shadows were obtained in 8 (16 per cent) of the Priodax cases and in 11 (22 per cent) of the tetraiodophenolphthalein cases. Moderate and good shadows were obtained in 68 per cent of the Priodax studies and in only 40 per cent of those with tetraiodophenolphthalein. These latter figures agree with those of Paul, Pohle, and Benson (5) for Priodax, but there is marked disagreement between the 40 per cent of the present series and the 72.5 per cent of their tetraiodophenolphthalein cases. Since in our series the percentage of cases showing no shadows with tetraiodophenolphthalein is 18 per cent higher than in their series, and since our figures for Priodax agree with theirs,

TABLE IV: SHADOW DENSITY: PRESENT SERIES COMPARED WITH THOSE RECORDED IN THE LITERATURE

Author, Dye, and Number of Cases	No Shadow	Faint Shadow	Moderate Shadow	Good Shadow	Remarks
Lauer-Schmaltz (9) Biliselectan (Priodax): 45 cases	11 (24.4%)	1 (2.2%)	....	33 (73.3%)	.....
Kleiber (6) Biliselectan (Priodax): 55 cases	25 (45.6%)	...	....	...	Others not classified
Rating (7) Biliselectan (Priodax): 96 cases	....	...	....	91 (94.8%)	Remainder not classified
Marshall (11) Priodax: 50 cases	10 (20%)	1 (0.5%)	....	15 (30%)	Others classified on pathological basis
Wash (10) Priodax: 134 cases	28 (20.9%)	12 (8.9%)	19 (14.2%)	75 (56%)	.....
Dannenberg (8) Priodax: 143 cases	31 (21.7%)		11 (7.7%)	101 (70.6%)	.....
Ochsner (12) Priodax: 300 cases	93 (31%)		201 (67%)		Only figures given
Hefke (13) Priodax: 600 cases	60 (10%)	12 (2%)	48 (8%)	480 (80%)	.....
Paul, Pohle, and Benson (5) Priodax: 114 cases	29 (25.4%)	3 (2.6%)	10 (8.7%)	72 (63.3%)	.....
Tetraiodophenolphthalein: 80 cases	16 (20%)	6 (7.5%)	14 (17.5%)	44 (55%)	.....
Present series Priodax: 50 cases	8 (16%)	8 (16%)	11 (22%)	23 (46%)	.....
Tetraiodophenolphthalein: 50 cases	19 (38%)	11 (22%)	15 (30%)	5 (10%)	.....

the difference in the figures of the two series for moderate and good shadows with tetraiodophenolphthalein cannot be accounted for by the personal equation, which might enter into an evaluation of the density of the shadows.

TABLE V: SHADOW DENSITY IN 15 PATIENTS RECEIVING BOTH PRIODAX AND TETRAIODOPHENOLPHTHALEIN

Dye	No Shadow	Faint Shadow	Moderate Shadow	Good Shadow
Priodax	3	1	4	7
Tetraiodophenolphthalein	8	4	2	1

Tables V and VI show our observations relative to shadow density in 15 patients and the 10 normal persons receiving both dyes. On the basis of the examination with Priodax, 10 of the 15 patients would not be considered to have gallbladder disease, because of the moderate and good shadows obtained. However, of the same 15 patients, 9 would be considered definitely diseased, and 4 probably so, when tetraiodophenolphthalein was used. The

discrepancy between the figures in Table V and the ones listed here lies in the fact that in one case with opaque stones there was a moderate or good shadow with both preparations. It should also be noted here that one patient without x-ray evidence of gallbladder disease with either dye was later operated upon and found to have a cholecystitis with hemorrhages into the mucous membrane.

As was expected, in all of our 10 normal subjects a gallbladder shadow was demonstrable. Two, however, had a faint shadow with tetraiodophenolphthalein and would have required a second examination had they been patients.

One of the great advantages of Priodax is the fact that there is little or no residue of the drug in the colon. With tetraiodophenolphthalein, such a residue is an almost constant occurrence; it is frequently sufficient in the hepatic flexure to obscure a normal gallbladder shadow. In 5 of our cases, these confusing shadows were the major obstacle to an accurate interpretation. In all 5 cases, the difficulty was eliminated by resorting to the use of Priodax.

TABLE VI: SHADOW DENSITY IN 10 NORMAL SUBJECTS RECEIVING BOTH PRIODAX AND TETRAIODOPHENOLPHTHALEIN

Dye	No Shadow	Faint Shadow	Moderate Shadow	Good Shadow
Priodax	0	0	1	9
Tetraiodophenolphthalein	0	2	3	5

This advantage is mentioned in several reports in the literature but few stress its importance. Because of it, Priodax is not only more accurate, but it aids in the simplification of cholecystography, for as stated by Dannenberg (8), "No alkalies, drugs, pressor agents or paregoric are necessary," and to this we add the annoying enema or enemas.

SUMMARY

The results obtained in a series of 100 patients referred for x-ray examination of the gallbladder in which Priodax and sodium tetraiodophenolphthalein were alternated are reported. The results of the examination of 15 patients and 10 normal persons given both dyes are included. These results are tabulated on the basis of side reactions and shadow densities and are compared with the observations of others recorded in the literature.

CONCLUSIONS

Beta - (4 - hydroxy - 3,5 diiodophenyl) - alpha-phenyl-propionic acid—Priodax—is superior to sodium tetraiodophenolphthalein because it simplifies and at the same time increases the accuracy of cholecystography.

Priodax is more pleasant to take. Severe nausea occurs infrequently compared with its incidence following tetraiodophenolphthalein. Diarrhea is less severe. Gastro-intestinal symptoms occur more frequently, however, than is suggested by the first reports on the drug or the claims made for it.

The new drug has a great advantage over sodium tetraiodophenolphthalein in that it

produces shadows of the gallbladder more consistently, and usually of greater density. Gallbladder shadows are better visualized because of the absence of confusing opaque shadows in the hepatic flexure of the colon. From our experience this reliability appears of greater importance than the reduction in side reactions. This fact has not been stressed in previous reports.

Our findings vary from other published reports, but most of the latter present only the results obtained after the use of the new drug. Because the present series is small, it is hoped that other similar investigations, comparing the two drugs, will be made.

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March Fracture¹

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"MARCH FRACTURE" is a term applied to a fracture occurring typically in infantry recruits during training periods involving a great deal of marching. In contrast to the usual fracture, a march fracture does not result from a single definite traumatism. Formerly thought to be limited to the metatarsal bones, march fractures have now been reported by various authors in most of the weight-bearing bones of the lower extremity and pelvis (3). The terms "fatigue fracture," "stress fracture," "strain fracture," "insufficiency fracture," and "skaters' fracture" are synonymous with "march fracture." In civilians the condition is said to occur with some frequency in waitresses, shop attendants, and nurses as a result of the prolonged walking and standing in their respective occupations (4); a similar fracture has been reported in children (5).

ETIOLOGICAL CONSIDERATIONS

The war program of infantry training was extremely strenuous, being planned to condition physically and train the recruit as a soldier within a period of a few months. The introduction of "speed marches" and prolonged hikes up to twenty-five miles placed a severe burden on the physique of the soldier in training. Practically every soldier was subject to much greater physical stress in the army than he had been as a civilian. As a result, march fractures were of common occurrence in the infantry troops undergoing training. In our experience these fractures are confined to no particular type of individual. We believe that they occur in a bone which is unused to strenuous activity and which has not accommodated itself quickly enough to accept the increased stress placed upon it. March fractures are at a minimum in well seasoned troops, in whom conditioning has apparently added

tensile strength to bone and related structures. The exact mechanism of the fracture has not been proved. Recently Breck and Higinbotham (2) have popularized the theory that the fracture occurs as a result of a molecular rearrangement of the bone, due to multiple small traumata; this rearrangement is thought to render the bone brittle and liable to fracture. Watson-Jones (6) describes the fracture as a simple crack fracture, which is so fine in character that it is frequently missed; it is not until new callus appears that the typical roentgen findings are present.

SYMPTOMATOLOGY AND FINDINGS

The typical complaint is pain following a march, during which the soldier had been unable to keep up with his company. The pain is usually well localized to the affected area, which is tender on palpation. Gross swelling is evident on examination in case of the subcutaneous bones of the foot and leg. Motion of the adjacent joints in their extreme ranges may produce slight pain. In contrast to traumatic fractures, the ecchymosis due to soft-tissue injury is absent.

By far the most frequent site of march fracture is the shaft of a metatarsal, particularly the second or third (Fig. 1). The earliest roentgenographic sign is an incomplete subperiosteal fracture or a slight area of periosteal reaction (Fig. 1, A), from which usually develops a line of fracture extending completely across the bone. Displacement of the distal fragment (Fig. 1, B), as well as slight angulation, may occur at the fracture site. If the first evidence of fracture is recognized and strenuous activity is reduced, a complete fracture line may not occur. Healing usually ensues with abundant callus formation which is gradually absorbed in a period of months to form a dense, spindle-like thickening at the fracture site (Fig. 1, D).

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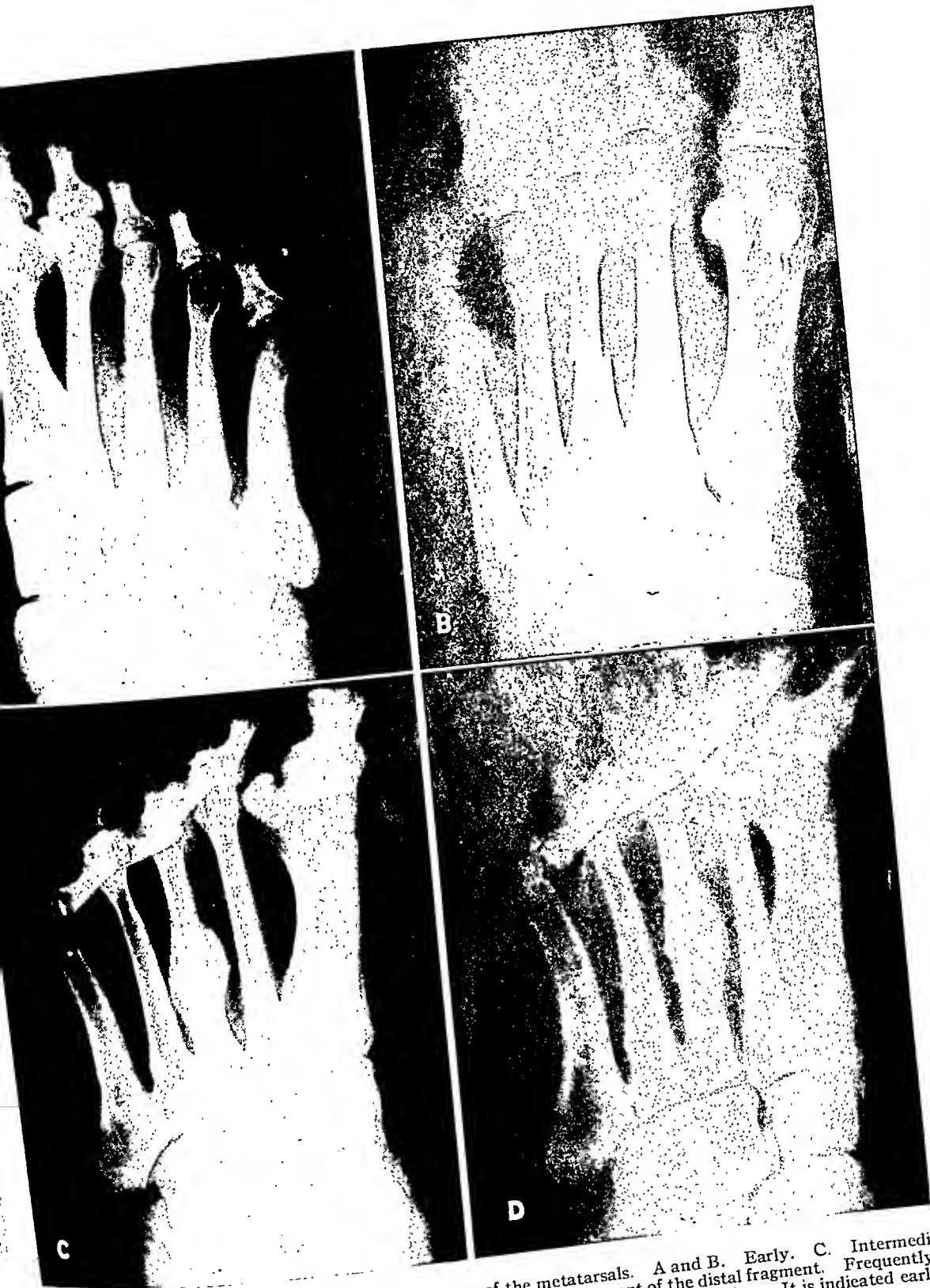


Fig. 1. Examples of various stages of march fractures of the metatarsals. A and B. Early. C. Intermediate. D. Late. In B the fracture line is complete, and there is displacement of the distal fragment. Frequently, the line of fracture is not quite so marked (B) and in instances may not go on to completion. It is indicated early by slight periosteal reaction, which increases as the process extends. C is a march fracture in intermediate stage, with ambulatory treatment, showing the large amount of callus, a complete fracture line, and slight displacement. The fracture shown in D, which also received ambulatory treatment, is firmly healed by a dense spindle-shaped callus.

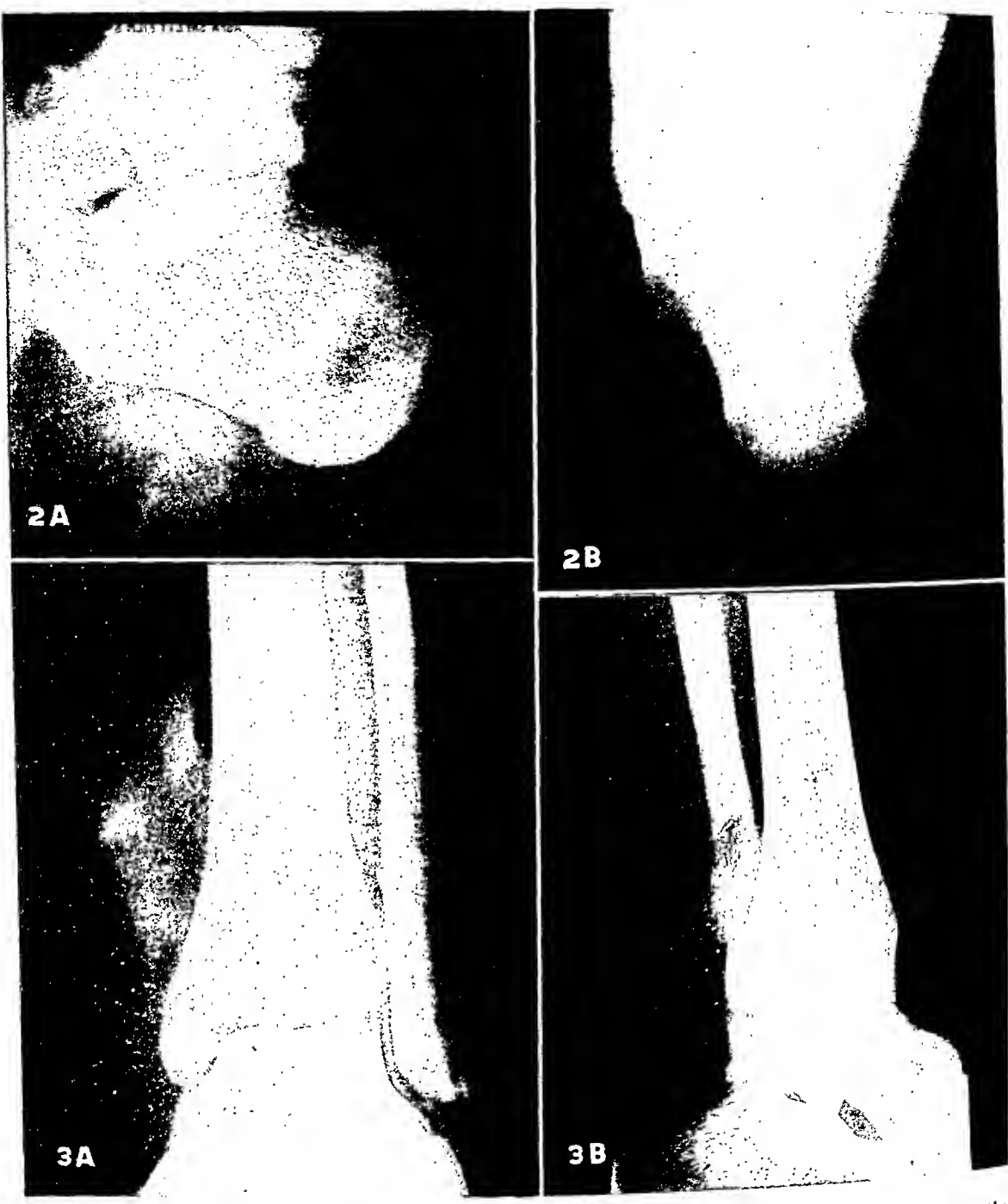


Fig. 2. March fracture of the os calcis, evidenced by a band-like line of condensation extending about the waist of the bone. Examining the periphery, one will see a piling of periosteal bone-callus formation. We have never seen displacement in fractures in this region.

Fig. 3. March fracture of the distal shaft of the fibula, a fairly common site. In this fracture there is no displacement. Displacement occurs in march fracture when the line of fracture has been complete early and the fracture has not been immobilized.

A common cause of painful heels in infantry soldiers is march fracture of the os calcis (Fig. 2). It is evidenced roentgenographically some days after the onset of clinical symptoms by a line of bony

condensation extending across the waist of the bone. At the margin of the fracture line the cortical bone shows a periosteal reaction, best seen on the axial (plantar-dorsal) view (Fig. 2, B).

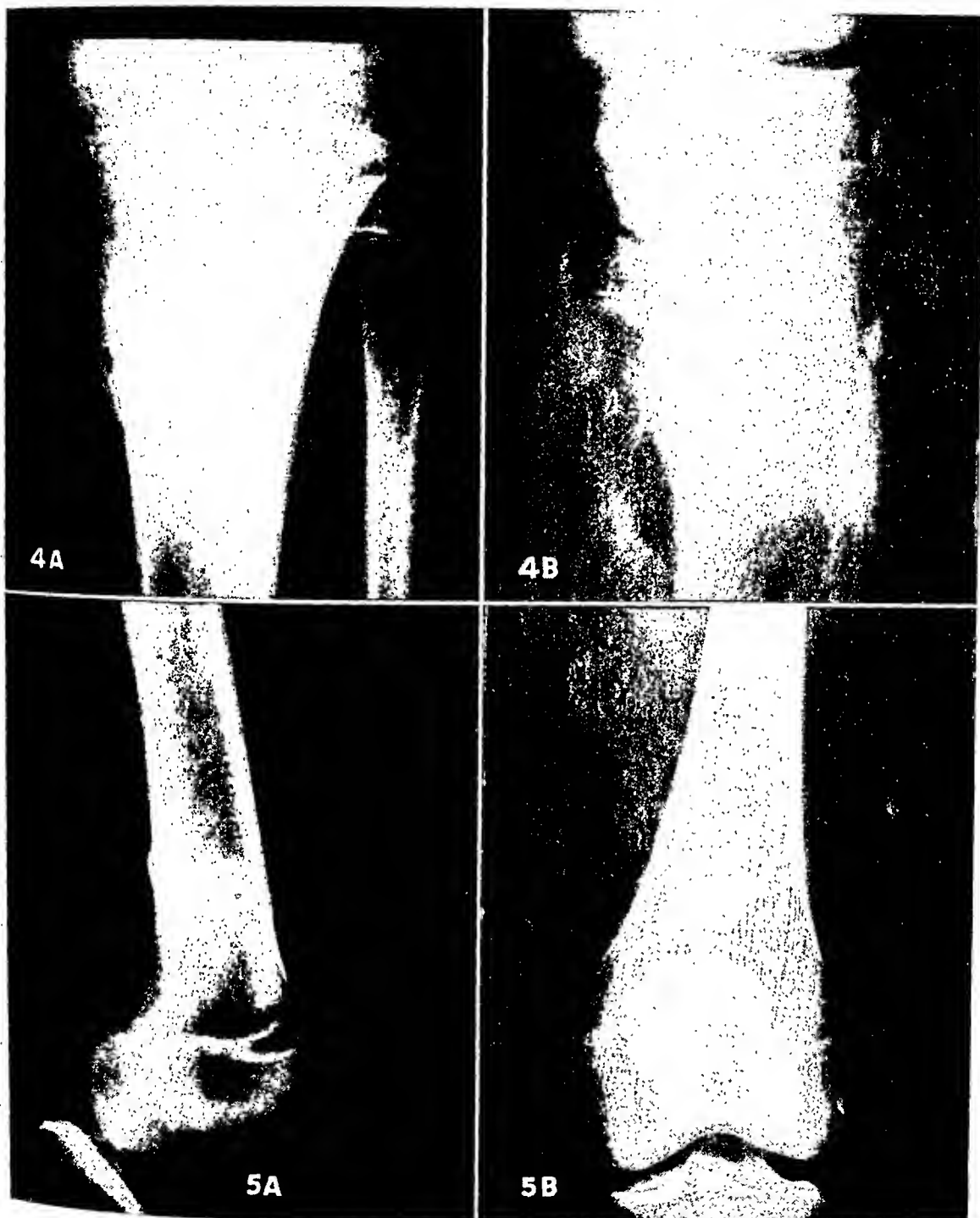


Fig. 4. March fracture of the upper shaft of the tibia. The upper shaft of the tibia is a frequent site of march fracture. In this example there is a complete fracture line, great callus formation, and no displacement.

Fig. 5. March fracture of the femur, a rather more infrequent site. Here again is a complete fracture line and considerable callus formation without displacement.

The long bones of the extremities are not infrequently the site of march fracture. In our experience the tibia is second in frequency only to the metatarsals. Too fre-

quently these fractures in the lower leg are overlooked as "shin splints." In the tibia the upper third of the shaft is more frequently affected (Fig. 4); in the lower por-



Fig. 6. March fracture of the base of the neck of the femur, an unusual site. There is no doubt as to correctness of diagnosis in this case. The patient was a husky young soldier of 22 who had worked as a farmer up to time of induction. Pain in hip was induced by walking, six weeks after entrance upon infantry training. Healing occurred without incident following restricted activity only.

tions of the shaft the subperiosteal reaction does not often develop into a complete transverse fracture line. In the fibula the distal portion of the shaft is most often involved (Fig. 3).

March fractures of the femur are seen less frequently; when present, they are likely to involve the lower third of the shaft (Fig. 5); more unusual is involvement of the femoral neck (Fig. 6).

The pelvis is a rare site of march fracture. Such fractures have received little general recognition as a cause of inguinal and hip pain in infantry soldiers. Usually the pubic rami are involved (Fig. 7).

DIAGNOSIS

The diagnosis is usually not difficult in the presence of a typical history, symptoms, and findings. The early periosteal reaction seen roentgenographically may be confused with a malignant growth (6). If the diagnosis is in doubt, a biopsy should be performed. In the opinion of the writers, this is seldom necessary.

PROGNOSIS

The prognosis in all march fractures is good as regards healing of the fracture. Certain patients continue to complain of mild pain after the lesion has healed. Any given march fracture may be followed by a similar fracture in another or the same weight-bearing bone; occasionally we have observed multiple successive march fractures in one individual.

TREATMENT

In treatment of these fractures we have recently come to place considerable em-



Fig. 7. March fracture of the pubis, in this instance bilateral. The patient, a 27-year-old soldier, complained of bilateral inguinal pain following a 3-mile "speed march." At the time he had been in infantry training only seven weeks. In our experience march fracture in this site is less frequent than in other bones.

phasis on ambulatory treatment at the suggestion of the orthopedic consultant of the Eighth Service Command. Such treatment prevents disuse atrophy of muscle and bone. Only in early cases with extremely acute symptoms is complete rest indicated. As soon as practical, the patient is allowed to be up and about with certain restrictions. In case of march fractures of the metatarsals without displacement, the patient's shoe is fitted with a longitudinal steel bar according to the plan of Bernstein and Stone (1). This permits completion of the greater part of his training program. March fractures of the metatarsals with displacement must be immobilized for a four-week period in a

walking cast if further displacement is to be avoided. With march fractures of the os calcis, restricted ambulatory activity is allowed, with no marching, drilling, prolonged walking or standing for a period of eight to ten weeks after the acute symptoms have subsided. Similarly, march fractures of the long bones and pelvis require a period of many weeks of restricted ambulatory activity before full functional activity may be resumed; the clinical and roentgenographic findings will determine when a return to full activity may be permitted in a given case.

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Hiatus Hernia of the Stomach as a Source of Gastro-Intestinal Bleeding¹

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HIATUS HERNIAS of the stomach and their complications, such as peptic ulcer and gastritis, are a grateful field for roentgen diagnosis. Clinical symptoms of great variety, often as alarming as sudden hematemesis, can be explained by roentgen demonstration of the displaced segment of the stomach. The importance of including hiatus hernia of the stomach in the differential diagnosis of bleeding lesions of the upper gastro-intestinal tract will justify the presentation of three additional cases of this kind recently observed on the medical service of Sparks Memorial Hospital.

The general classification of the diaphragmatic hernias and the mechanism leading to the displacement of portions of the stomach through the esophageal hiatus into the thorax, the so-called hiatus hernia, have been presented in excellent papers (4, 8). The hiatus hernia may or may not be combined with a congenitally short esophagus, the presence of which plays an important, but not an exclusive, part in the origin of this condition. Insufficiency of the muscular hiatus and of the surrounding connective tissue, acquired with advancing age, is considered the decisive etiologic factor. The positive pressure within the abdomen gradually forces segments of the stomach through the weakened hiatus into the thorax, where negative pressure exists.

Sixteen cases of hiatus hernia of the stomach have been observed in 1,000 consecutive gastro-intestinal examinations in the x-ray departments of Sparks Memorial Hospital and the Holt-Krock Clinic. This number includes only cases in which a sizable barium deposit outlining a gastric mucosal pattern was demonstrable above the diaphragm. A reflux of barium into



Fig. 1. Case 1. Large hiatus hernia of the stomach. The esophagus is rather short. The hernia is quite irregularly outlined, suggestive of swelling of the mucosal pattern.

the lower esophagus due to relaxation of the cardiac sphincter was more frequently found, but such cases are not included in this series.

The majority of the patients with true hiatus hernia were beyond fifty years of age. There were 8 females and 8 males. In a surprisingly large proportion of the cases, 5 out of 16, the diaphragmatic hernia was complicated by other lesions in the gastro-intestinal tract, an observation which has likewise been made by other authors (6). Duodenal ulcers were found in 2 cases, primary adenocarcinoma of the ileum with intestinal obstruction in another, while the 2 remaining patients showed multiple diverticula in the colon.

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The combination of diaphragmatic hernia with diverticulosis of the colon is well explained by the fact that both conditions are due to senile insufficiency of muscular and connective tissue.

In 3 of the 11 cases in which no other gastro-intestinal lesion was present, the hiatus hernia was practically asymptomatic. In 5, different degrees of epigastric pain and other digestive symptoms were

precordial pain, which could be relieved only by opiates. The patient was admitted Aug. 16, 1943, with a tentative diagnosis of coronary thrombosis.

During the first few days in the hospital, attacks of substernal pain continued, combined with shortness of breath and cyanosis. There was frequent vomiting of small amounts of dark blood. The patient was unable to retain food. The physical examination was not significant. The blood pressure was 155/80. An electrocardiogram (routine three leads) done immediately on admission revealed a normal rhythm. There was some evidence

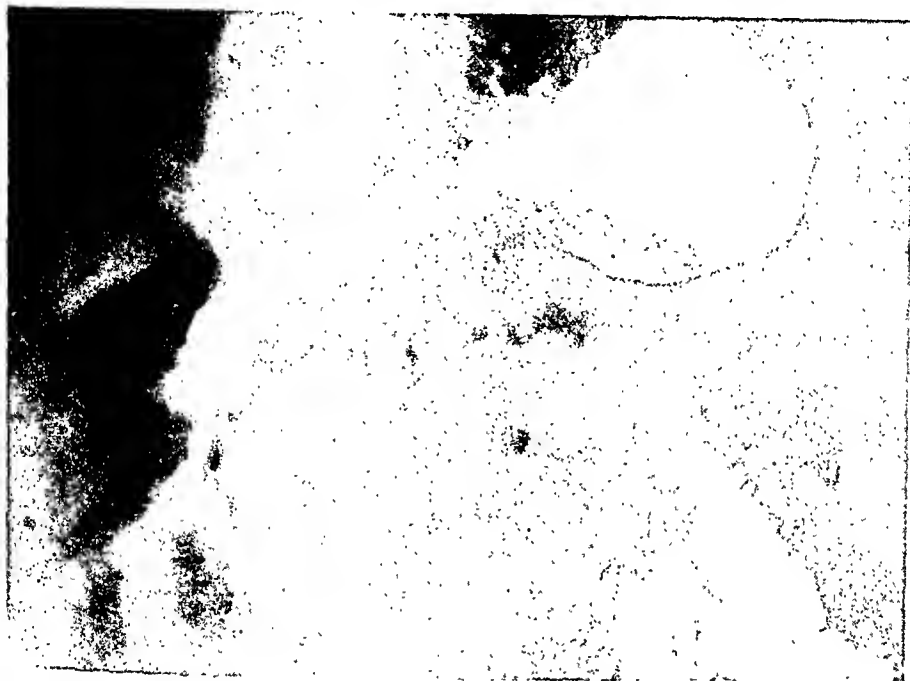


Fig. 2. Case 1. Note the gastric mucosal relief extending distinctly above the diaphragm.

recorded, and sufficiently well explained by the presence of the herniated stomach. A small peptic ulcer was found in only 1 of these patients. There was satisfactory response to medical management in all cases in this group.

Clinical symptoms of a bleeding lesion within the gastro-intestinal tract, manifesting itself in either hematemesis or microcytic anemia, brought the remaining 3 patients for x-ray examinations.

CASE 1: B. B., a white male, 65 years of age, gave a past history which was not contributory except for a syphilitic infection which had been treated adequately. For the past two weeks he had experienced occasional vomiting of small amounts of dark blood and dark brown liquid. There were no other digestive symptoms. The night before admission there occurred a sudden onset of severe

of myocardial damage, but no change suggesting a recent infarction (Dr. C. T. Chamberlain).

Treatment consisted of sedation with large doses of opiates, glucose parenterally, and oxygen. The condition of the patient gradually improved, and vomiting stopped after five days in the hospital.

Laboratory findings were as follows: red cell count 4,200,000, with hemoglobin 94 per cent; white cell count 6,150, with a normal differential; NPN 35.2 mg./per cent; urinalysis negative. Wassermann and Kahn reactions negative.

X-ray examination revealed a hiatus hernia of the stomach the size of an egg. The herniated portion of the stomach had an irregular outline and showed a coarse mucosal relief suggestive of a localized gastritis.

CASE 2: W. R. A., a white male, 45 years of age, gave a past history of no significance. He had been feeling perfectly well when, three hours before admission, he suddenly started to vomit large amounts of bright red blood. He was admitted as an emer-



Fig. 3. Case 2. The elongated and tortuous esophagus enters the herniated portion of the stomach. Note constriction where the stomach passes through the muscular hiatus.

gency June 25, 1944, at 12:30 A.M., in a state of mild shock. Physical examination was not remarkable. No further bleeding occurred while the patient was in the hospital. He received several transfusions of plasma and whole blood and was discharged after a short observation period.

The red cell count was 3,480,000, with hemoglobin 70 per cent; white cell count 10,350 with neutrophils 80 per cent, lymphocytes 20 per cent. On the second day the hemoglobin dropped to 54 per cent and the red count to 2,610,000. Urinalysis revealed a trace of albumin and several hyaline casts.

X-ray examination showed the presence of a large hiatus hernia of the stomach which was irregularly outlined along its anterior wall. No ulcer was demonstrable. The upper gastro-intestinal tract was otherwise normal with the exception of a spastic duodenum.

The patient was again seen after six weeks of medical management. He felt perfectly well and had had no further episodes of hematemesis. His hemoglobin was up to 90 per cent, his red cell count to 4,830,000. A check-up study again revealed the hiatus hernia of the stomach. The duodenum was

now normally outlined, and any organic lesion in this area could safely be ruled out. Gastric analysis (fasting specimen): free HCl 12, combined acid 18. The highest values reached following a test meal were: free HCl 32, combined acid 46.

CASE 3: Mrs. J. H. H., white female, 69 years of age, had had pneumonia in 1926 and undergone a cholecystectomy in 1927. Her present complaints were weakness, some loss of weight, anorexia, and shortness of breath combined with pain in the lower chest. She was admitted on Dec. 21, 1943.

On physical examination the patient appeared chronically ill but in rather good nutritional state. The heart appeared enlarged toward both sides. The blood pressure was 155/98. The lungs were clear. There were no masses palpable within the abdomen. The electrocardiogram (done in routine three leads) showed evidence of myocardial changes, but not the typical picture of coronary disease (Dr. C. T. Chamberlain).

The red cell count was 2,760,000 with hemoglobin 52 per cent; white cell count 7,550 with neutrophils 61 per cent and lymphocytes 39 per cent. NPN 36 mg./per cent. Urinalysis was negative. The findings on gastric analysis were as follows (fasting specimen): free HCl none, total 50; the highest values reached following a test meal were free HC 100, total 130.

A barium enema study revealed a spastic and irritated colon, but no evidence of an organic lesion within the large bowel. Studies of the upper gastro-intestinal tract showed a large hiatus hernia of the stomach and a short esophagus. A small ulcer was clearly demonstrable, located posteriorly at the junction of the esophagus with the herniated portion of the stomach. The intra-abdominal part of the stomach and the duodenum were normal in appearance. The patient was put on an ulcer regime and received large doses of vitamin B, iron, and liver preparations. Her condition improved steadily, and she was discharged after a hospital stay of three weeks. The last blood count before discharge revealed a hemoglobin of 84 per cent and a red cell count of 4,390,000. A check-up examination of the gastro-intestinal tract in April 1945 again showed the large hiatus hernia. The mucosal folds within the herniated portion of the stomach were swollen and widened. The ulcer had, however, disappeared.

COMMENT

The important characteristic common to all three of the cases reported above is that each seemed to typify a rather frequent clinical picture, and that the discovery of the hiatus hernia of the stomach came as an unexpected but satisfactory explanation of the condition. Case 1 gave a strong impression of cardiac disease; in Case 2 the

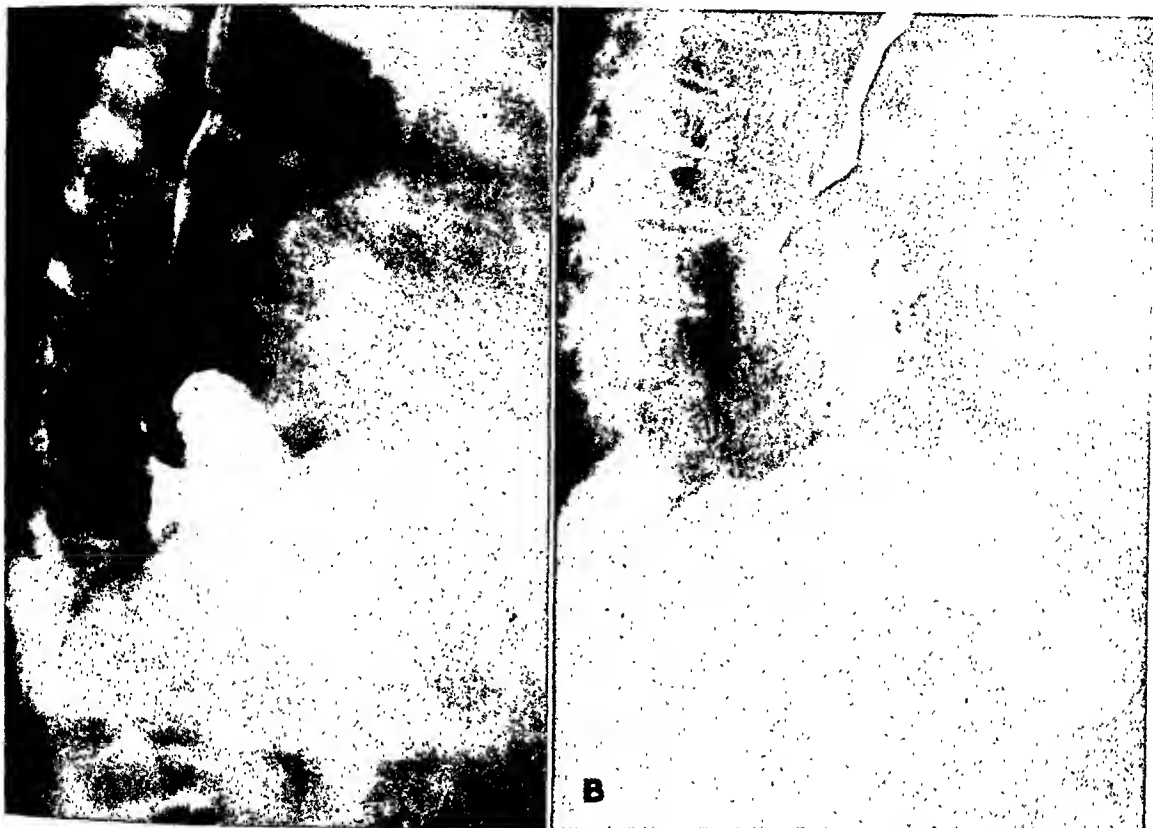


Fig. 4. Case 3. A. Large hiatus hernia of the stomach. The ulcer, located posteriorly at the junction of the esophagus with the herniated portion of the stomach, is clearly shown. Note constriction where the stomach passes through the muscular hiatus.

B. A check-up study, made sixteen months after the first examination, fails to reveal the ulcer previously found. The localized swelling of the mucosal folds within the herniated portion of the stomach is well shown.

history and age of the patient called for a diagnosis of a bleeding duodenal ulcer, while Case 3 was highly suggestive of a malignant neoplasm within the gastrointestinal tract.

The cause of bleeding in hiatus hernia is considered to be venous congestion in the herniated portion of the stomach due to muscular compression of the diaphragm (2, 9). The swollen and congested mucosal layer can easily be traumatized, with the production of superficial bleeding erosions or deeper ulcerations (3). The accompanying attacks of precordial pain found in Cases 1 and 3, suggesting an acute coronary occlusion or more chronic anginal seizures, have been observed by several authors (5, 7) and can well be attributed to the constriction of the herniated stomach by the diaphragm, combined with pressure upon the heart itself.

It may be noted that in the two patients

with substernal pain a moderate hypertension was found. The electrocardiogram, however, ruled out a recent myocardial infarction or coronary sclerosis sufficiently advanced to account for the attacks of precordial pain. A large ulcer could be demonstrated only in Case 3. This patient showed considerable hyperacidity and responded well to ulcer management.

We feel that the subsequent clinical course in these three patients has substantiated the diagnosis, but it is obvious that hiatus hernia can be established as a cause of intestinal bleeding and accompanying pain only if every other possible source of bleeding has been ruled out by a thorough clinical and x-ray study and continued observation of the patient.

SUMMARY

1. Hiatus hernia of the stomach can be a source of intestinal bleeding, manifesting

itself in hematemesis, melena, or microcytic anemia.

2. Three cases of this kind are presented and the etiology of the bleeding is discussed.

3. The symptoms of hiatus hernia may simulate coronary artery disease.

4. Other more commonly observed intra-abdominal conditions may be mimicked by hiatus hernia, requiring complete differential diagnostic studies.

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ADDENDUM

Since this paper has been completed an additional case of bleeding in hiatus hernia has been observed.

CASE 4. Mrs. A. R., white female, aged 48, gave a past history of no significance. For three years she had experienced almost daily attacks of substernal pain, aggravated by eating. Other complaints were frequent vomiting of bright red blood and "coffee-ground" material, occasional shortness of breath, and some loss of weight. Repeated examinations for pulmonary tuberculosis had been negative. The patient's condition had become suddenly worse during the last two or three weeks.

Physical examination on Jan. 3, 1946, was essentially negative, except for revealing some tenderness in the epigastrium. The blood pressure was 120/80. The red cell count was 4,390,000, with hemoglobin 90 per cent; white cell count 6,950. Gastric analysis (fasting specimen): free HCl 5, total 20. The highest values reached following a test meal were free HCl 24, total 46. The electrocardiogram (routine three leads) revealed no definite evidence of myocardial changes other than left axis deviation; normal sinus rhythm (Dr. C. T. Chamberlain).

X-ray examination demonstrated a hiatus hernia of the stomach, with a short esophagus, the herniated portion representing about one-third of the entire stomach. There were definite swelling and enlargement of the mucosal folds within the thoracic portion of the stomach but no evidence of an ulcer.

Comment: This case represents well the misleading history and the rather negative clinical findings in a patient with a hiatus hernia of the stomach. Some of the symptoms are quite suggestive of heart disease, while the repeated expectoration of bright red blood had led the patient to seek consultation for pulmonary tuberculosis.

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Lymphoblastoma of the Kidney¹

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THE GENERALIZED character of the lymphoblastoma group of diseases is well known. Involvement of the lymphatic system is most common, whereas invasion of the lungs, bones, nervous system, gastro-intestinal tract, and skin also is found frequently, particularly in the later stages of the diseases. Renal lesions of this type are recognized clinically less often than the others, although they are observed fairly frequently at autopsy.

In a clinical analysis of 196 proved cases of lymphosarcoma, Sugarbaker and Craver made no mention of kidney involvement, either as a primary focus or secondary invasion, although twenty-one other organs were listed as being secondarily involved. Barney, Hunter, and Mintz pointed out the paucity of references to the urologic aspects of the "radiosensitive tumors of the blood-forming organs" and described, among others, a case of lymphosarcoma with a grapefruit-sized mass in each loin which was the result of extensive infiltrations in the kidneys. According to these writers, such infiltrations can produce oliguria and uremia. Price described a case of unilateral lymphosarcoma of the kidney in a child with hematuria for four days at the onset of his illness; the involved kidney was removed and found to weigh 600 gm. In a case of acute lymphatic leukemia in a three-week-old infant, White and Burns found enlargement of the kidneys to four times their normal size. The nature of the enlargement presented a problem in diagnosis until the leukemic blood picture was discovered. Another report of a case of lymphatic leukemia which presented bilateral infiltrations of the kidneys with leukemic tissue is described in the Case Records of the Massachusetts General Hospital. Among 125 cases of Hodgkin's disease and

lymphosarcoma, Locke and Minot observed paroxysms of abdominal pain and hematuria in three cases, which they attributed to a urological manifestation of the disease. In these cases the external manifestations of the condition were not prominent. Clute discussed involvement of the urinary tract by "malignant lymphoma" and stressed the importance of diagnosis to avoid mistreatment. He stated that the signs and symptoms may simulate one of the more usual forms of kidney disease, or may be only of a general nature, but held that the diagnosis probably would be made if the condition were kept in mind.

According to Ewing, the kidney is a favorite site for metastases from lymphosarcoma, which may take the form of minute foci, diffuse infiltrations, or bulky masses. Baldridge and Ave found microscopic evidence of kidney involvement in 20 out of 39 cases of lymphoma, the highest incidence occurring in lymphocytic lymphoma with leukemia. On the other hand, Griffin and Brindley discovered 6 cases of lymphosarcoma among 3,865 cases at autopsy, none of which showed renal infiltration. In 4 out of 18 cases of leukemia, Merrill and Jackson found extensive gross and microscopic involvement of the kidneys. They pointed out the relationship of such infiltrations to the development of uremia in leukemia. It would seem that the leukemic forms of lymphoblastoma may be associated with a higher incidence of renal involvement.

Infiltration of the capsule of the kidney by lymphoblastoma may occur without extension into the parenchyma. Mathé described one such case wherein there was obliteration of the lower major calix on one side, giving the appearance of intrarenal tumor. Secrétan's case similarly showed thickening of the capsule on both sides by

¹ From the Department of Pathology, University of Texas, Galveston. Accepted for publication in May 1945.

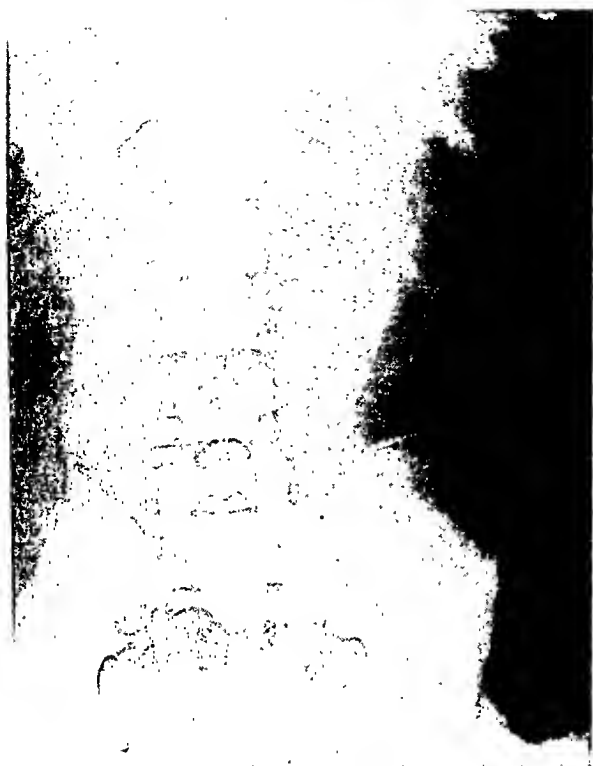


Fig. 1. Intravenous pyelogram. The left side is best visualized and reveals the enlargement and elongation of the pelvis and calices. The superior major calix is well shown and appears elongated and somewhat narrowed. Only a stump of the middle calix is seen.

tumor, with no parenchymal invasion. The left pyelogram was said to show elongation of the pelvis and calices, consistent with the appearance of polycystic kidneys; the right pyelogram was normal. No explanation was offered for this difference in appearance nor for the production of the pelvic and caliceal elongation.

The case to be reported is one of unusual interest, not only because of the presence of massively enlarged kidneys in a case of lymphosarcoma, but because the pyelographic studies revealed a similarity to polycystic kidneys. We have been unable to find a similar case in the literature.

CASE REPORT

A. P., a 17-year-old white male, was admitted to the John Sealy Hospital on May 4, 1944. He had been well until five months previously, at which time he had a cold accompanied by cough and whitish sputum and diffuse joint pains, which had persisted. Three months before admission he observed bilateral swelling about the angles of the jaw; at the same time there was persistent abdominal pain. For a month prior to admission he had complained of

parietal and occipital headaches, nocturia, and polyuria, as well as intermittent deafness of the right ear. For three weeks there had been afternoon temperature elevations and, for a week, bleeding from the gums.

The patient was a well developed boy who appeared chronically ill. There were large, firm, rubbery and discrete lymph nodes in the occipital, anterior cervical, submaxillary, axillary, and inguinal regions. The blood pressure was 128/78,



Fig. 2. Retrograde pyelogram of the right kidney. The pelvis is elongated transversely and enlarged. The superior and inferior major calices show considerable elongation, and the superior one is somewhat narrowed. The arc-shaped lateral border of the middle calix is shown.

and there was a systolic murmur at the aortic area. The abdomen was enlarged and the flanks bulged; the liver and spleen could not be felt. There was a large mass in the upper abdomen on either side, each measuring approximately 10 X 6 X 6 inches. These masses appeared to be retroperitoneal and did not move with respiration.

Repeated examination of the blood showed increasing anemia and thrombocytopenia. The leukocyte count varied from 9,900 to 14,450 per c. mm. before irradiation, and 4,000 to 13,000 after irradiation. There were about 50 per cent lymphocytes, as well as "lymphosarcoma cells," in the blood smear. The non-protein-nitrogen level was consistently elevated, varying from 66 to 93 mg. per cent. The urine contained slight amounts of albumin and concentrated to a maximum specific

gravity of 1.016; there were no erythrocytes or leukocytes in the urinary sediment. A sternal biopsy revealed a hyperplastic marrow with extensive lymphosarcomatous infiltration. The pathologic diagnosis upon biopsy of a lymph node was "lymphoblastoma." The cells showed numerous mitoses and there was invasion of the capsule.

A flat film on May 15, 1944, showed a diffuse homogeneous area of density obscuring the upper part of the abdomen. This area had a rounded lower border and it appeared to extend below the level of the crests of the ilium on each side. Following the injection of 30 c.c. of 35 per cent diodrast, there was poor excretion on the right side, with only small amounts faintly visible in some of the calices. On the left side (Fig. 1) the pelvis was elongated transversely and somewhat enlarged. The superior and inferior major calices were considerably elongated and the superior calix was narrowed as well. Only a stump of the middle calix was seen. The minor calices were curved and failed to show their normal cupping. The upper ureter was displaced medially over the third and fourth lumbar vertebral bodies.

A retrograde pyelogram was made on the right side one week later (Fig. 2). The appearance was essentially the same as on the left side. The superior and inferior calices were lengthened. The middle calix was short and broad and its minor calices showed no cupping. The lateral border of these minor calices was arc-shaped.

Radiotherapy was administered, 12.5 r in air being given on three alternate days at a focal-skin distance of 100 cm. This treatment was discontinued because of leukopenia, but had resulted in subjective improvement for about a week. In spite of repeated transfusions, the anemia and hemorrhagic tendency persisted and the patient expired six months after onset of his illness.

Pathologic Report: There were 1,500 c.c. of clear yellow fluid in the abdominal cavity, and 500 c.c. in each thoracic cavity. The serosal surfaces were flecked with petechial hemorrhages. The abdominal organs were displaced downward by the enlarged kidneys. The liver was enlarged, weighing 2,360 gm., and revealed a firm grayish parenchyma. The spleen weighed 500 gm. and had scattered areas of recent infarction. There were varicosities of the esophageal veins and one had ruptured recently. There was enlargement of the mediastinal, periaortic, axillary, inguinal, and cervical lymph nodes. The lungs were congested, with hypostatic pneumonia at the bases. The heart weighed 340 gm., and the myocardium was soft and pale. Both kidneys were enormously enlarged, measuring approximately $25 \times 15 \times 15$ cm.; the right one weighed 2,320 gm., and the left 2,450 gm. Their surfaces were reddish and smooth; the cut surfaces revealed a homogeneous reddish parenchyma with distortion and elongation of the pelvis and calices (Fig. 3).

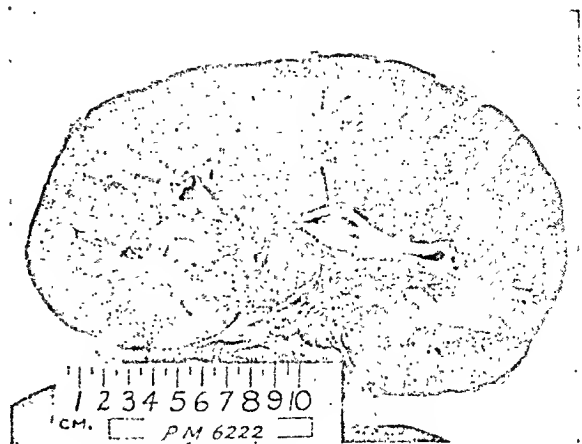


Fig. 3. Right kidney in cross section. This kidney weighed 2,320 gm. In the fresh state the surface was reddish, due to numerous hemorrhages. The compression and elongation of the calices due to extensive invasion by lymphosarcomatous tissue are evident.

Microscopic examination revealed a lymphocytic infiltration of the liver, spleen, prostate, testes, thyroid, hypophysis, and lymph nodes. The lymph nodes were entirely replaced by lymphocytes with mature nuclei and scant cytoplasm. The kidneys showed a wide separation of the degenerated tubules and glomeruli; the intervening stroma was densely infiltrated with lymphocytes. In many areas there were disintegration of the capillary walls and considerable hemorrhage.

DISCUSSION

The clinical picture of bilaterally enlarged kidneys and moderate azotemia, together with the suggestive roentgen appearance, was considered to be strong evidence in favor of a diagnosis of polycystic disease of the kidneys. It is worth noting that intravenous pyelography was done in spite of a non-protein-nitrogen level in the blood of almost three times the normal value, and a satisfactory filling of the pelvis and calices on the left side was obtained. With a proved diagnosis of lymphosarcoma by lymph node and sternal biopsy, lymphosarcomatous infiltration of the kidneys had to be considered in an attempt to explain the clinical observations. It was generally considered, however, that the pyelograms were more consistent with the appearance of polycystic kidneys, particularly since such an appearance had not been described previously in a case of lymphoblastoma of the kidney.

It is well known that tumors of the kid-

ney may produce a pyelographic appearance resembling polycystic kidneys. The calices are elongated and narrowed in either case, but when due to tumor this compression usually is greater, with the result that they may be attenuated to fine linear streaks. This is the so-called "spider-leg" deformity. Moreover, in the case of tumors, the distal portions of the calices show a distinct tendency toward dilatation (Caulk). In polycystic kidneys, however, there are arc-shaped depressions of many of the calices and even the pelves are elongated in a superoinferior direction (Kerr and Gillies). As a rule, there is little difficulty in differentiation, since polycystic disease of the kidney is nearly always bilateral, whereas neoplasms of the kidney usually are unilateral (Beilin and Neiman).

Taking into account these criteria of the radiologic diagnosis, one can perceive that the roentgenograms in this case presented features of both polycystic disease and tumor invasion, although not typical of either condition. Apparently the presence of cysts or of masses of lymphosarcomatous tissue may produce similar distortion of the calices.

It is suggested that in cases of bilateral kidney enlargement lymphoblastomatous involvement be considered in the differential diagnosis. A pyelographic appearance simulating bilateral tumor or polycystic disease may be viewed as suggestive evidence, while a positive lymph node biopsy or a leukemic blood picture can be considered as further confirmation.

SUMMARY

1. Lymphoblastoma of the kidney is an infrequent clinical diagnosis. It is a common finding in pathologic material and would seem to occur more often in cases with a leukemic blood picture.

2. Primary lymphosarcoma of the kidney is a doubtful entity, since enlargement of the retroperitoneal nodes usually is present as well.

3. Lymphoblastomatous infiltration of the capsule may produce a filling defect in

the pyelogram resembling a parenchymal lesion.

4. A case of lymphosarcoma with infiltration of the kidneys is reported. The pyelograms bore some resemblance to polycystic disease or bilateral tumor, and a definite antemortem diagnosis could not be established.

5. When lymphoblastoma is considered in the differential diagnosis of bilateral kidney enlargement, the pyelographic appearance and leukemic blood picture are of aid in arriving at the diagnosis.

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Paragonimus Westermanii: A Case Report¹

CAPT. THOMAS H. BREM, M.C., A.U.S., and CAPT. HAROLD A. COHN, M.C., A.U.S.

INFESTATION with the trematode *Paragonimus westermanii* (or lung fluke) is said to be of common occurrence in China, Japan, Formosa, and the Philippines, where it is the cause of "endemic hemoptysis." In our own experience with approximately 20,000 Chinese hospital admissions, the disease has been observed but once, although we have been well aware of the condition and have made repeated wet-mount sputum examinations in patients with unexplained hemoptysis.

The disease is contracted by ingestion of the fresh-water crab or crayfish, which harbors the larval form. The larvae promptly develop and make their way through the intestinal wall into the peritoneal cavity, and thence through the diaphragm, into the lung parenchyma, where they become encysted and produce symptoms. These flukes may be found in other viscera as well, even the brain, but the lungs are the site of predilection. Ova are produced in large numbers and coughed up in sputum which is characteristically mucoid and rusty, not unlike that seen in pneumococcus pneumonia.

The fluke is described as thick and fleshy, oval in shape, and measuring 8 to 20 mm. in length by 5 to 9 mm. in breadth. In pathologic specimens tumor-like swellings are seen throughout the lung, mostly peripheral and outlined beneath the pleura. The parasites are contained within these nodules. Sections of the lung reveal scattered areas of infiltration, in which are "burrow-like" cavities containing the flukes. These smaller channels may coalesce to form a larger cavity with bronchial communication.

CASE REPORT

A 28-year-old Chinese soldier was admitted to the hospital on Sept. 22, 1943, because of coughing up

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blood. During the previous three or four years there had been frequent episodes of hemoptysis, with production of large amounts of blood especially during or after strenuous physical exertion. At times there were sharp pains in both sides of the chest, not noticeably associated with respiration. There had been shortness of breath on exertion and some loss of weight in the preceding two months, during which hemoptysis had been continuous. The patient had not felt feverish nor had there been night sweats. There was no history of bleeding from other orifices.

The patient had been in the army one year. Prior to that he had spent his whole life in Szechuan Province. He had never lived on, or even been near, any large body of water and could not remember having eaten crabs, crayfish, or any other shellfish. His mother and grandmother were said to have been chronic blood spitters; his father had died with generalized swelling, and he had two siblings, both of whom were healthy with no history of hemoptysis.

The patient was well developed and fairly well nourished. His temperature was 97.8° F., and his blood pressure 108 systolic and 68 diastolic. The mucous membranes were of fairly good color and no icterus was present. Eyes, nose, and throat were normal. There was no enlargement of the peripheral lymph nodes. The trachea was in the mid-line. Both sides of the chest moved well, equally and synchronously on inspiration. The percussion note was normally resonant, and the breath sounds were normal. No adventitious sounds were audible. The heart was not enlarged, the rate was moderate, and the rhythm regular. Heart sounds were of normal character and no murmurs were present. The abdomen was soft and not tender. The spleen was plainly palpable, firm but not tender, just below the left costal margin. Liver and kidneys were not felt. Genitalia and extremities were negative, and no abnormal neurological signs were found.

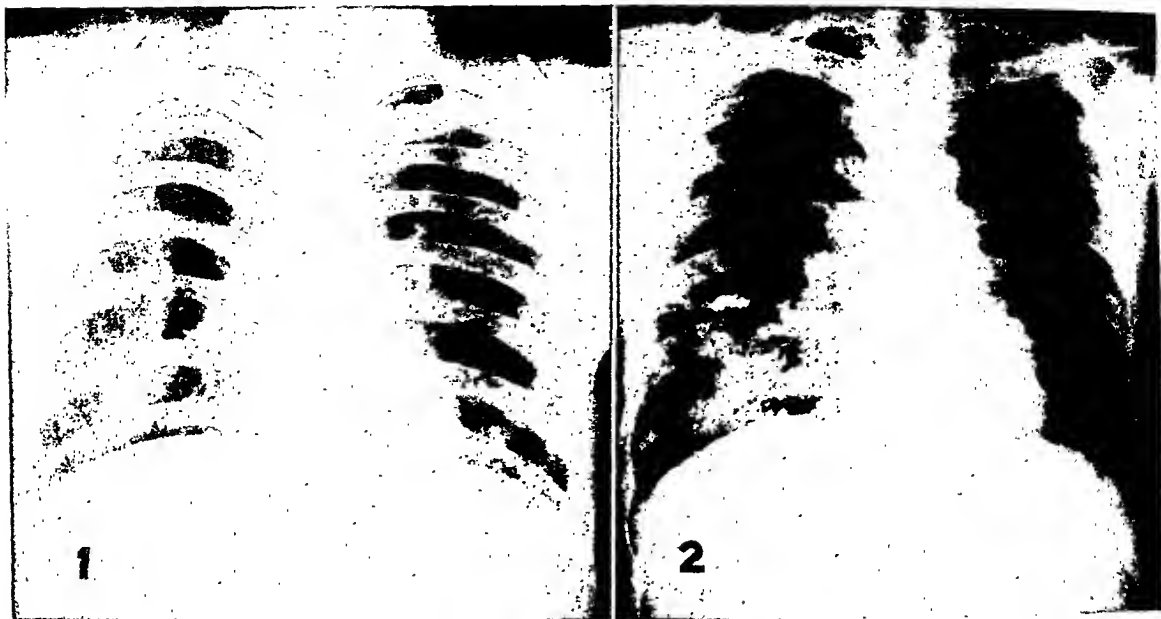
The white blood count was 8,000 with 44 per cent polymorphonuclears, 12 per cent eosinophils, 42 per cent lymphocytes, and 2 per cent monocytes.

Urine was negative, but the stool contained many *Ascaris* and occasional *Trichuris trichiura* ova.

The sputum was rather copious, mucoid in character, containing reddish brown clots of blood. The wet mount revealed red cells, pus cells, and epithelial cells. No acid-fast bacilli were found.

The chest film at the time of admission showed exaggeration of the right basal truncal markings, but nothing more.

The course was afebrile, and the patient at no time appeared to be ill. He continued to cough up large quantities of mucopurulent sputum containing



Figs. 1 and 2. Roentgenograms made Oct. 20, one month after admission, and Nov. 19, following administration of lipiodol. For description, see text.

masses of dark brown blood. Accordingly, broncho-
scopic examination was performed, with the idea of
a bronchial papilloma in mind. The bronchoscopi-
st's² report read: "Larynx, trachea, and carina
normal. Left bronchial tree normal. Mucosa on
medial wall of right main bronchus redundant and
granular just opposite the orifice of the right upper
lobe bronchus. Remainder of right bronchial tree
normal. No bleeding."

A few days later a stool specimen was sent to the
laboratory. Fortunately the patient had expecto-
rated into the specimen cup, and on making the
mount for the examination, this bloody mucoid ma-
terial was used. Unexpectedly a large number of
unfamiliar ova were seen, which soon were identified
as those of *Paragonimus westermani*.

The diagnosis thus accidentally being established,
the problem of treatment remained. A rough egg
count was done daily by emulsifying the sputum in
an equal amount of saline and examining a drop
under a coverslip through the microscope. The
daily count averaged 25 to 30 ova per coverslip, but
occasionally a single low-power field contained that
number.

The patient was given a five-day course of eme-
tine hydrochloride, 32 mg. twice daily administered
intramuscularly. No diminution in the number of
ova produced was noted.

Thereupon, as a therapeutic as well as diagnostic
measure, lipiodol was instilled into the bronchi. No
roentgenologic abnormalities were demonstrable ini-
tially, and the output of ova was not reduced.

A second course of emetine was administered, this
time covering seven days, but with no effect. Fi-

nally neoarsphenamine, 0.45 gm., was given intrave-
nously. Concurrently there was a fall in the egg
count to an average of 8 per coverslip. A second in-
jection caused no further reduction, and a few days
later the count began to rise until new highs were
reached, on one examination 600.

We had hoped to try other drugs, especially anti-
monials, but none were then available. Inasmuch as
the patient apparently suffered no constitutional
effects from his infestation, he was discharged to
duty on Dec. 21, 1943, three months after his
admission.

Roentgen Study of the Chest: The initial film of the
chest showed only some exaggeration of the right
basal bronchovascular markings with otherwise clear
lung fields. Subsequent films showed a progressive
coarsening and coalescence of these markings, pro-
ducing a diffuse zone of infiltration at the right base
which became most marked about a month after ad-
mission (Fig. 1). A review of the films showed a per-
sistent radiolucent area within this zone simulating
a cavity. A later study showed some clearing of the
infiltration, but a radiolucent channel was still seen,
suggesting a "burrow" cavity. No infiltration was
ever identified in the remainder of the lung fields.

Lipiodol filling of the right middle and lower lobes
showed what was interpreted as a normal bronchial
tree. In subsequent films showing residual lipiodol
in the alveoli, a persistent dense globular collection
was noted in the approximate location of the previ-
ously identified cavity. This measured 5 to 8 mm.
in diameter and was surrounded by a radiolucent
zone (Fig. 2). Though its significance may be dis-
puted, we think it might represent a collection within
a "burrow" channel or even a collection of lipiodol
about the fluke.

² Capt. A. S. Churchill, M.C.

COMMENT

Many of our Chinese patients with unexplained hemoptysis showed chest films with coarsened basal pulmonary truncal markings, often associated with infiltration of a non-specific nature similar to that shown here. Parasitic infestation was often suspected, but in only this one case was there positive laboratory confirmation. Our x-ray findings correspond to those described and expected from pathologic studies. The almost negative chest picture on admission, in spite of an acute clinical episode of hemoptysis for two months followed

by a progressive infiltrative lesion while in the hospital, is a matter of interest and speculation. The recommended therapeutic measures were ineffectual.

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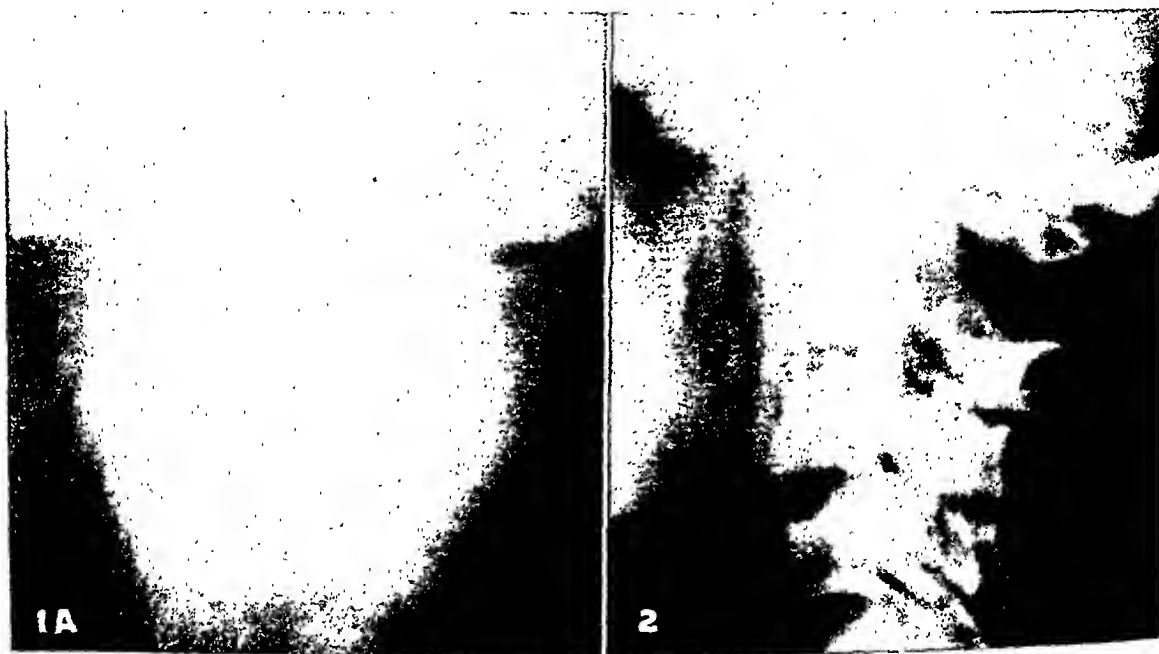


Two Cases of Spinal Anomaly, Best Demonstrated by Laminagraphy¹

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and CAPT. LEWIS G. JACOBS, M.C., A.U.S.

OCCASIONAL mention of hemivertebra is made in the radiological literature. The anomaly is not rare, having been found in the lumbar spine in 3 per cent of 3,000 spines examined by Brailsford. In this Army General Hospital, hemivertebra

In spite of the relatively frequent occurrence of this anomaly, the two cases reported here seem well worth attention: the first because of the fact that no case of hemi-atlas was found in a search of what literature was available to us; the second



Figs. 1-2. Case 1. Figure 1A is an anteroposterior laminagraphic study, showing the anomalous development of the cervical region. The findings are shown diagrammatically in Figure 1B. Figure 2 is a conventional lateral view showing the close relationship of the first cervical segment to the occiput.

was demonstrated in 2 of 376 (0.5 per cent) examinations of the cervical spine, in 1 of 556 (0.2 per cent) examinations of the thoracic spine, and in 1 of 2,025 (0.05 per cent) examinations of the lumbar spine.

because extensive maldevelopment of the spine was present with little clinical evidence. It is worthy of note that in neither case was conventional roentgenography sufficient to show the nature of the anomaly present. In both instances laminagraphy led to a clarification of the picture.

The first patient was a white male, aged 21, who entered Sept. 11, 1944, because of pain in the neck for two weeks. Several weeks earlier, he had been struck in the back of the neck during routine boxing for physical conditioning. He experienced

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immediate pain and gradually increasing tenderness of the cervical muscles, especially on the left, with some limitation of motion. Physical examination showed the head and neck to be held rigid as a protective mechanism. There were tenderness and limitation of all extreme motions of the neck, and especially of rotation. No deformity was present. There was no radiating pain. Routine laboratory studies were normal. Conventional studies of the cervical spine failed to demonstrate the anomaly. Therefore, laminagraphic study was made, with the findings illustrated in Figures 1-3. These were interpreted as an assimilation of the atlas in the occiput with a supernumerary hemi-atlas on the left (strictly speaking, this partial vertebra consists of a lateral mass only). Bed rest and leather traction for fourteen days led to relief of symptoms, but the patient was eventually discharged.

The second patient was a 32-year-old white man who had complained of cough and expectoration for five to six years. In the course of routine studies, including chest films and bronchography, a dextrocardia and thoracic deformity were discovered. On subsequent questioning, the patient stated that his right shoulder had been higher than the left since childhood. When about eight years old, he had tried to help his father, an ice man, with his duties but had been forced to stop because of backache. He was forced to discontinue employment in an aircraft factory for the same reason, although his employment required only the use of a rather cramped posture. He had lumbar pain on lifting heavy objects at the time of the present observation. On physical examination of the skeletal system the right shoulder was found to be slightly elevated. There was a sharp scoliosis to the right in the upper thoracic region. The right sternocleidomastoid muscle was more developed than the left. The right sternoclavicular joint was normal in position; the left was about an inch lower and appeared enlarged. The right anterior chest was slightly more prominent than the left. Other findings

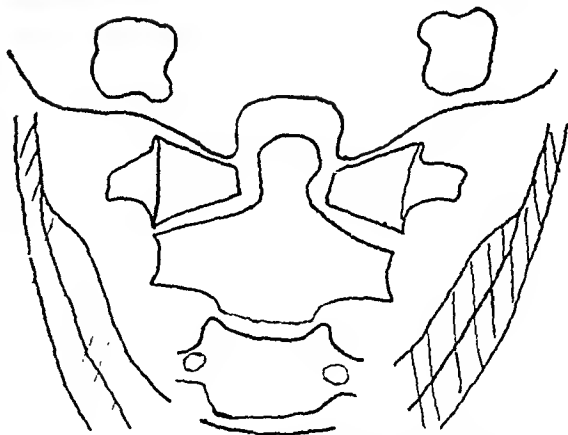
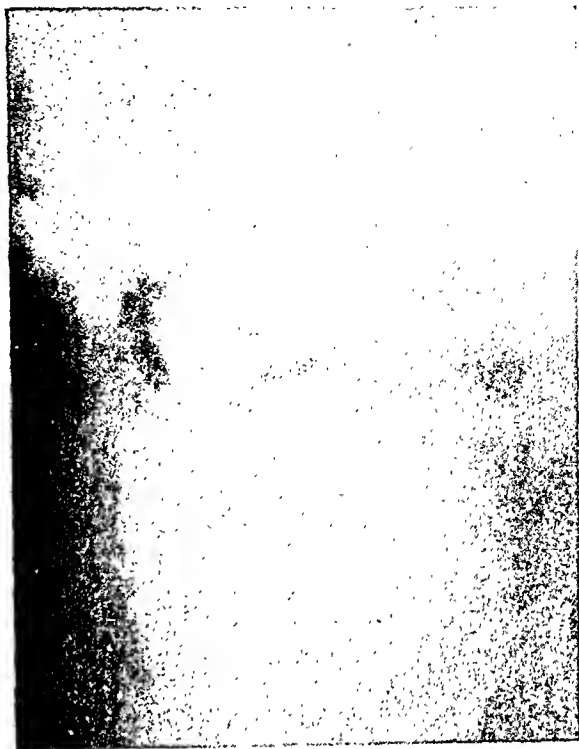


Fig. 3. Case 1. Normal laminagraphic study of the upper cervical region with illustrative line drawing, for comparison.

were those of an acquired dextrocardia, thought to be attributable to the thoracic deformity.

X-ray examination (Figs. 4-6) showed fusion of the posterior elements of the 4th, 5th, 6th, and 7th cervical vertebrae on the right and of the posterior elements of the 5th and 6th vertebrae on the left. The right elements were incompletely formed, suggesting partial hemivertebrae. There was incomplete closure of the laminae of

Spontaneous Renocolic Fistula: Report of a Case¹

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A FISTULOUS communication between the kidney and colon constitutes an exceedingly rare clinical entity, being referred to only casually in the average textbook of urology. Despite the fact that Hippocrates first made mention of this condition, Mertz (1), in 1931, succeeded in collecting only 26 cases over the intervening centuries. Since the excellent clinical and anatomical review of the subject by Vermooten and McKeown (2), 12 additional cases have appeared in the literature. The most recent, and by far the most unique, recorded by Markowitz and Katz (3), was a fistulous connection between the lower pole of a double kidney and the colon. Careful analysis of the literature does not tend to indicate an increased frequency of occurrence, but rather an earlier recognition of chronic kidney disease by improved diagnostic procedures and proper surgical management.

The first thorough investigation of renocolic fistula was done by Rayer (4), who believed that a chronic infection of the kidney produced the initial lesion, the adjacent colon becoming attached by fibrous adhesions with subsequent ulceration and fistula formation. To date, no instance of the condition has been reported as a result of a primary bowel lesion. The investigations of Wesson (5), Ratliff and Barnes (6), and Higgins and Hicken (7), show fistula formation to be incident to a chronic suppurative process of the kidney with an associated perinephritis or perinephric abscess. Ratliff also points out that tuberculosis was the least frequently encountered causative agent, occurring only five times in 37 cases reviewed, while renal calculi accounted for 14 cases and 18 were collectively listed as of inflammatory origin.

The outstanding symptoms of renocolic fistula are chills and fever, renal colic, and tumor in the flank, which disappears with

dramatic suddenness following perforation and evacuation of pus into the bowel. Except in a few of the early cases which were discovered at necropsy, the diagnosis has been made by urographic methods. Hirsch and Bass (8) are of the opinion that the lesion may go undiagnosed unless retrograde studies are made. Wesson (5) and Feldman (9) have each diagnosed a case with the aid of a barium enema.

CASE HISTORY

A 42-year-old Austrian-born housewife was admitted to the hospital because of intermittent pain in the chest. Approximately nine months prior to admission, without preceding injury, she experienced a dull aching pain in the lower left chest, which was not aggravated by deep breathing. She denied cough, hemoptysis, or dyspnea, but gave a history of associated high fever with chills and night sweats.

A local physician treated her for "pleurisy," and the symptoms gradually subsided. A month later, the pain recurred, but in a more disabling manner, and failed to respond to the therapeutic measures previously administered. One evening a diarrhea developed, which was followed by marked weakness and the patient fainted. When she regained consciousness, the pain had subsided and she was able to perform limited household duties the following day. Her general condition steadily improved and she gained a little weight. Several months later, a series of "boils" appeared over her body, and these were followed by an osteomyelitis in the distal shaft of the left radius. Treatment by incision and drainage brought about resolution of the process, but with some residual stiffness of the fingers and limitation of flexion at the wrist.

Because of a return of the old chest complaint and two weeks of chills and fever with associated severe night sweats, the patient reported to the Outpatient Department for treatment. A chest film showed a suspicious infiltration in the left apex and it was felt advisable to admit her for observation.

The general appearance of the patient was that of a chronically ill and rather poorly nourished middle-aged woman. Her temperature was 101.8° F., pulse 120, respirations 24. The red blood cell count was 4,600,000, with 11.5 gm. of hemoglobin; the white cell count was 6,000, with a normal differential count. The urine showed albumin 1+, with 25 red cells per high-power field, but was otherwise negative. Physical examination was not particularly revealing except for a soft blowing systolic murmur

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at the cardiac apex; the lungs were clear throughout to auscultation and percussion. The abdomen was soft, and the lower pole of the right kidney was easily palpated but not tender. No bulge was detected in either flank, but there was slight tenderness on deep palpation in the left flank. Because of the previous osteomyelitis, together with the physical and laboratory findings, an infection in or about the left kidney was suspected and intravenous pyelography was done.



Fig. 1. Retrograde pyelogram demonstrating free communication between the upper calix of the left kidney and a short segment of bowel.

The urogram revealed a normally shaped but ptotic right kidney with good function and normal architecture. The left kidney was somewhat smaller than the right and excreted the media to a limited degree; the calices appeared distorted, and a fine granular type of calcification clearly outlined the lower pole. The psoas margins were smooth and without defect. A tuberculous left kidney was suspected and retrograde pyelograms were then made to aid in evaluation of the excretory urograms.

Cystoscopy revealed no gross abnormality of the urinary bladder. The right ureteral orifice was normal, but the left showed an efflux of purulent material which prevented free drainage. The P.S.P. test was normal on the right but showed marked delay on the left. Bladder urine was negative for tubercle bacilli or other organisms. Twenty-five red cells were present, with only an occasional white cell.

Ureteral catheters were easily passed to each kidney pelvis and contrast medium was instilled in the usual manner, though the operator did notice that the solution was injected into the left catheter with greater ease than on the right. Thinking that perhaps there was an escape of the medium about the catheter, he accordingly doubled the amount with-

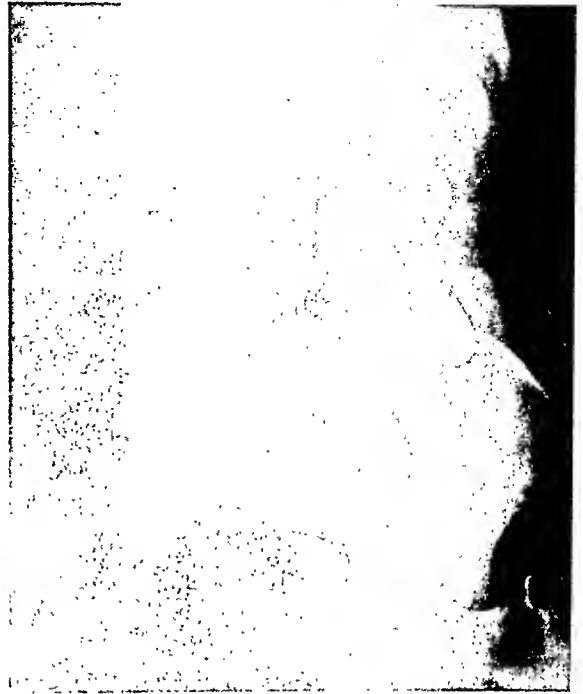


Fig. 2. Second roentgenogram, made after instillation of an additional 75 c.c. of medium, clearly outlining the caliceal defect and free communication with the descending colon.

out discomfort to the patient, and the first roentgenogram was taken (Fig. 1). The generalized distortion of the calices of the left kidney is clearly shown with an extravasation of the medium outlining what appeared to be a short segment of bowel. An additional 75 c.c. of dye was then injected, and the second roentgenogram clearly outlined a long segment of colon distal to the splenic flexure (Fig. 2). A barium enema, given in an effort to visualize the fistulous communication, failed to demonstrate any defect or regurgitation into the kidney, thus indicating that the flow was in one direction only (Fig. 3).

In the interval since admission, repeated chest roentgenograms had shown no essential change in the fine linear infiltration in the left apex of the lung, and frequent sputa examinations were negative for tubercle bacilli.

A transverse colostomy was performed to divert the fecal stream. One month later, a small left kidney was exposed through a routine renal incision. An abscess measuring 5 cm. in diameter was located between the kidney and the adjacent lumbar musculature, with a second abscess, 8 cm. in diameter, between the diaphragm and perirenal fat. Each was filled with a mixture of blood and purulent material which had no odor. Because of the dense adhesions encountered about the renal bed, it was not until the kidney was removed that the defect in the superior pole, suggested by the pyelograms, was revealed. A 5-mm. opening was rather easily located in the descending colon about 8 cm. distal to the splenic flexure and was closed with a single purse-string su-

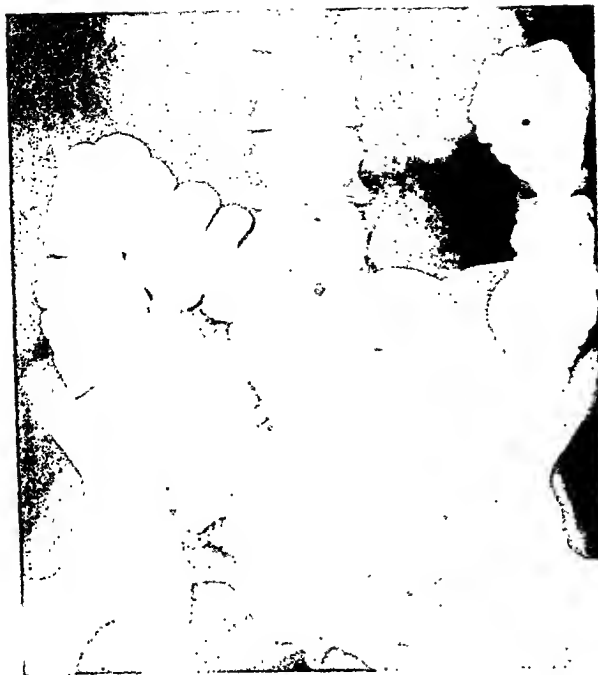


Fig. 3. Barium enema study, showing failure to define any marginal defect of the colon or reflux of barium into the kidney.

ture. The colostomy was subsequently closed without sequelae.

Postoperatively, multiple sinus tracts developed in the incision and a large abscess cavity in the kidney bed was evacuated, with prompt cessation of drainage and spontaneous closure of the sinuses. Of the frequent gastric washings cultured, one specimen, on the 55th day, eventually proved positive for the presence of tubercle bacilli. There was, however, no appreciable alteration of the linear infiltration in the left apex during the period of hospitalization.

SUMMARY

1. The literature of renocolic fistula has been briefly reviewed and a case of tuberculous etiology reported.

2. Fistulous communication between a kidney and the colon is incident to a long-standing suppurative renal process with associated perinephritis and perinephric abscess formation.

3. Primary bowel lesions have not accounted for any of the cases reported in the literature.

4. Early recognition of chronic renal disease by urographic studies, especially by retrograde methods, has accounted for an appreciable reduction in the incidence of renocolic fistulae.

5. Treatment consists of nephrectomy and closure of the fistula in the bowel.

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New York, N. Y.

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EDITORIAL

Radiology and Atomic Power

At the observance by the American College of Radiology, on Nov. 8, 1945, of the fiftieth anniversary of the discovery of x-rays, Dr. Robert S. Stone spoke, appropriately enough, on "Radiology from Roentgen to the Era of Atomic Power." Already this address has appeared in a number of medical publications¹ and it will undoubtedly be reprinted in others. While it will not be published in this journal, so great is its significance for radiologists that not at least to call attention to it in these pages would be a serious editorial oversight.

As Dr. Stone points out, the discovery of radioactivity was fundamental in that it revolutionized man's idea of the structure of the universe. Prior to that discovery, the atom of any given substance was considered to be indivisible and immutable. Now certain atoms were found to be breaking up and, in the process, producing atoms of other elements. Thus from an atom of radium there is given off a small particle which forms the nucleus of a helium atom, while the larger part remaining constitutes the nucleus of the atom of radon. It was discovered, also, that the emitted particle was possessed of energy which could be effectively used to bombard other atoms and effect their transmutation. Continued experimentation finally established the fact that the atom is made up of a central nucleus—itsself composed of protons and neutrons—surrounded by electrons, and that, except in the case of hydrogen, it can be broken up by appropriate methods.

In 1939 a new type of reaction was discovered. It was found that if one of the three known isotopes of uranium were

bombarded with neutrons, some of the atoms burst apart into two completely different atoms of about equal weight but the combined weight of the newly formed atoms was less than that of the parent uranium atom. This phenomenon, known as "fission," is accompanied by the freeing of a vast amount of energy—equal to the mass lost multiplied by the square of the velocity of light. Moreover, the neutrons released by fission of one atom may be captured by other uranium atoms, which themselves divide, giving off more energy and neutrons in a so-called chain-reaction. One outcome of this was the controlled chain-reacting pile; another was the large-scale atom splitting, whose tremendous potentialities for destruction were demonstrated in the last days of the war.

For the physician and biologist these chain reactions are of interest from a wholly different point of view, for they have a constructive aspect which, if less spectacular than the destructive, may be equally significant. As Dr. Stone points out, they can provide, on a scale hitherto unapproached:

1. An abundant supply of the particular radioactive isotopes formed in the fission process.
2. A supply of such other radioelements as can be made by bombardment with neutrons of the energies available.
3. A source of slow neutrons.
4. A source of fast neutrons.

The changes that these newly available tools will produce in medical procedure cannot be foretold. Some fields in which they have already been used with promising

¹ For example, *Am. J. Digest. Dis.* 12: ix, December 1945; *Mississippi Valley M. J.* 68: 13, January 1946.

results, though necessarily to a limited extent, are mentioned by Dr. Stone. These include metabolic studies, pharmacological research, diagnostic procedures with radioactive materials, and the treatment of disease.

Radioactive phosphorus and certain non-radioactive isotopes have been used with conspicuous success in determining the mechanism of many complex steps in metabolism, offering a hope of greater understanding of basic life processes. The use of very short-lived carbon isotopes has already advanced the knowledge of photosynthesis and, now that these will be available in larger quantities, the possibilities for further studies are greatly increased.

The use of radiophosphorus in the treatment of leukemia is well established, and promising results have been obtained in a series of cases of advanced cancer with fast neutrons. Radiostrontium has been shown to concentrate in growing osseous tissue, and its possibilities as a therapeutic agent in bone neoplasms and other diseases have been the subject of limited investigations. Similarly radio-iodine is selectively accumulated in the thyroids of patients with hyperthyroidism and has produced promising results in some cases of that condition. With the increased availability of radioactive materials, all these and many other lines of research are released from limitations to which they have hitherto been subject.

New fields of investigation are also opened up. The possibility that some chemical may be found which will lodge

selectively in malignant cells is one of the hopes of the future. If to such a chemical there could be attached a radio-element, a great stride might be made toward the effective treatment of cancer. Still another possibility is that of using certain radioactive materials created through the use of the chain-reacting piles for the development of treatment bombs with a content of curies more than tenfold that of the present day radium bomb.

"It is apparent," concludes Dr. Stone "that the age of nuclear energy was already here and being used by the medical profession before a chain-reacting pile was started. The science of nuclear change started when Becquerel was stimulated by the work of Roentgen. The discovery of radium by the Curies provided the first source of nuclear energy for medical and biological uses. The discovery of the phenomena of artificial radioactivity widened the field and the discovery of the cyclotron was a great stimulus to its advance because it increased the number and quantity of available radio-elements. Now the atomic power machines, by which is meant those machines utilizing the energy from fission to keep them in operation, have again expanded in an unlimited way the possibility for usefulness in research and therapy by radioactive isotopes.

"A new age has begun for medicine.... The pioneering spirit of those physicians who created the specialty of radiology under the stimulus of Roentgen's discovery must enter into their professional descendants and their fellow physicians so that medicine will advance into new fields."

ANNOUNCEMENTS AND BOOK REVIEWS

AMERICAN BOARD OF RADIOLOGY EXAMINATIONS

The American Board of Radiology will conduct examinations at the Palmer House, Chicago, Nov. 27 to Dec. 1, 1946. This will be the only examination held during 1946. All those wishing to appear before the Board at this time must have their applications on file by Sept. 1, 1946.

B. R. KIRKLIN, M.D.
Mayo Clinic, Rochester, Minn.

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY

The Mid-Summer Conference of the Rocky Mountain Radiological Society will be held on Aug. 8, 9, and 10, 1946, in Denver, Colorado, at the Shirley Savoy Hotel.

AMERICAN SOCIETY OF X-RAY TECHNICIANS

The American Society of X-Ray Technicians will hold their eighteenth convention at the Hotel Jefferson in St. Louis, Mo., June 10 to 14, 1946.

LEGION OF MERIT AWARDED TO DR. ROBERT S. STONE

Dr. Robert S. Stone of the University of California, more recently serving as visiting professor at the University of Chicago, was one of five distinguished scientists from the latter institution to be awarded the Legion of Merit for services in connection with the Atomic Bomb Project. The citation acknowledging Dr. Stone's services reads:

"As Chief of the Health Division of the MED project, for the Manhattan Engineer District, Army Service Forces, he was in charge of essential research and investigations of the radiation hazards involved in the operation of the entire project. A noted radiologist, Dr. Stone's sound scientific judgment, his initiative and resourcefulness, and his unselfish and unswerving devotion to duty have contributed vitally to the success of the Atomic Bomb Project."

LEGION OF MERIT AWARDED TO MAJ. MILTON FRIEDMAN

Major Milton Friedman of New York City, who from May 1942 to January 1946 was Chief of the Radiation Therapy Service at the Walter Reed General Hospital, has been awarded the Legion of Merit. The citation commended Major Friedman's services, "rendered with unselfish devotion to the welfare of the sick and wounded," and specially mentioned his invention of new and improved instruments and technics for the treatment of malignant growths.

W. H. MCGUFFIN, M.D., LL.D.

At a special medical convocation of the University of Western Ontario on March 27, 1946, Dr. W. H. McGuffin, who graduated from the University in 1910, was honored with the degree of Doctor of Laws. In conferring the degree, Dr. G. E. Hall, Dean of the Medical School, said: "Dr. McGuffin has been an example to our students and a typical alumnus who has directly and indirectly advanced the interests of the whole university."

On the same occasion Dr. McGuffin personally presented the W. H. McGuffin Prize in Radiology, which he endowed in 1939, to Donald Bruce Ferguson, one of the 36 students receiving the degree of Doctor of Medicine.

Letter to the Editor

HOSPITAL FLUOROPHOTOGRAPHY ITS IMPLICATIONS

To the Editor:

To those who have given consideration to the matter, there is little doubt that the use of fluorophotography in hospitals is going to be rather widely introduced during the coming year. The chief impetus to the program comes from the earmarking of certain funds for the purchase of fluorophotographic equipment by many of our State departments of health and State or local tuberculosis associations. A certain attractiveness to the idea immediately ensues, particularly on the part of hospital boards and superintendents, when it is learned that all or part of the necessary equipment to make such examinations may be obtained without cost. At times, let it be understood, certain provisions are being stated or at least recommended for its manner of use. Certain other hospitals, well endowed or in adequate funds for the purchase of photofluorographic units, are now in the act of obtaining them independently, upon the direct recommendations of their radiologists.

A letter of inquiry was recently addressed to the secretaries of each of the component State, city, or county radiologic societies listed in RADIOLOGY, stating briefly the trend of events as developed up to this time within the writer's home State of Wisconsin, requesting information regarding the development of the program in that part of the country represented by each secretary-addressee. The response was prompt and generous, some twenty-seven replies from all parts of the country being received in response to forty-nine inquiries.

These responses indicate a wide difference in the phase of development of the program in various parts of the country and also in the amount of

thought given and action taken by the various component societies of organized radiology in the United States.

The manner of procedure also has been found variable, a few hospitals planning to use the equipment primarily for nurses, medical students, interns, and hospital employees, or free clinic cases only, a larger group proposing to make the procedure mandatory for every admission (if not obtainable at time of admission, then at some time prior to discharge, when the patient's condition permits). Other replies indicated that the procedure was to be employed as regularly as it could be conveniently done or whenever requested, but that it would not be a compulsory measure required for every hospital admission. While the last-named arrangement would, of course, permit certain cases to pass in and out of a given institution without having the benefit of a miniature chest roentgenogram, it would not discourage the attending physician from bringing into the hospital an acute abdominal illness, head injury, or serious fracture case, nor would it discourage or duplicate survey work of industrial employees or other groups already being done quite widely in some States in physicians' offices or industrial plants (notably Wisconsin, where a pre-employment and re-examination program, including a routine miniature or full-size chest film, has been quite widely employed in the urban areas for the past eight to ten years).

Where the fee for this service has been considered or set, \$3 or \$2 was the figure usually stated. If we are right in believing the fundamental factors to consider in arriving at these fees are (1) cost of performing the examination, (2) its value to the patient, and (3) its ultimate effect on the entire radiologic fee schedule, this charge would appear to be a reasonable and fair one. In a half dozen or more localities a plan of remuneration of \$15 to \$25 per hour was stated, but this plan would obviously be more applicable where there was no individual fee charged each person examined and where the source of payment was some State tuberculosis association fund or an industrial corporation. In one reply it was indicated that the moneys so earned by the radiologists' cooperative efforts were to be turned over in their entirety to the treasury of the State radiologic body.

It has, of course, been emphasized on all sides that the fee must be kept in relation to other non-routine radiologic service charges in order to attract the largest possible number of examinations. On the other hand, it can fairly be pointed out that, in making such a study a more or less routine procedure with certain exceptions, as stated above, the true overhead cost in the department will increase out of proportion to the relatively modest cost of film used. This would, of course, not be true were it possible to employ "mass production" methods in performing the radiographic procedures (such as was done ideally, for example, on a large battleship

in the Pacific prior to the ending of the war, when approximately 3,000 naval personnel were studied by 35-mm. roll miniature film in a period of forty-eight hours, with no member of the personnel being off duty for longer than thirty minutes). In marked contrast, hospital admissions would come "one at a time" at all hours of the day and night and not be evenly spaced.

As stated at the outset, this program, under the impetus of free equipment, appears destined to rather widespread acceptance and application in the field of medical service in the hospital. It therefore behooves all physicians, particularly those doing hospital radiologic practice, to be aware of all the implications, to guide the program wisely, and be certain that the uses and limitations of the procedure be not misunderstood either by the physician or his patient.

J. EDWIN HABBE, M.D.
Milwaukee, Wis.
Jan. 31, 1946

In Memoriam

OPIE W. SWOPE, M.D.

Opie W. Swope, M.D., of Wichita, Kans., died on Dec. 12, 1945, at the age of 61. He was born in Lindside, Monroe County, West Virginia, in 1882 and was graduated from Maryland Medical College, Baltimore, in 1905. Shortly after he entered upon the practice of medicine his interests turned to radiology and he is to be classed among the pioneers in that field. He was a great champion of the curative value of x-rays and he had a tremendous following of grateful patients. He made both friends and enemies in a colorful and successful career. For a man to achieve his eminence with the handicaps of diabetes, deafness, tuberculosis, and cataracts is an achievement that may be considered almost superhuman.

Dr. Swope was a diplomate of the American Board of Radiology and a member of the American College of Radiology and the Radiological Society of North America. Radiologists have lost a real friend in their fraternity.

N. W. NASH, M.D.

JOSEPH S. GIAN-FRANCESCHI, M.D.

Dr. Joseph S. Gian-Franceschi of Buffalo, N.Y., died on Oct. 17, 1945, at the age of 61. Dr. Gian-Franceschi was a member of the staffs of the Emergent and Columbus Hospitals, Buffalo, and an associate staff member of the Lafayette Hospital. He was a diplomate of The American Board of Radiology, a member of the Radiological Society of North America and the American College of Radiology, and secretary and past president of the Buffalo Radiological Society.

Book Reviews

ROENTGEN DIAGNOSIS OF DISEASES OF THE GASTRO-INTESTINAL TRACT. By JOHN T. FARRELL, JR., M.D., Clinical Professor of Radiology, Graduate School of Medicine, University of Pennsylvania; Radiologist, Hermann Hessenbruch Memorial Department of Radiology, The Laukeman Hospital; Radiologist, Children's Hospital of the Mary J. Drexel Home; Roentgenologist, White Haven Sanatorium; Consulting Roentgenologist, Frederick Douglass Memorial Hospital; Consulting Roentgenologist, Mercy Hospital. A volume of 271 pages, with 190 illustrations. Published by Charles C Thomas, Springfield, Ill., 1946. Price \$5.50.

As Clinical Professor of Radiology in the Graduate School of Medicine, University of Pennsylvania, Dr. John T. Farrell, Jr., furnished his classes with mimeographed outlines of his lectures on the roentgen diagnosis of gastro-intestinal diseases. These outlines, repeatedly revised, form the nucleus of a volume which students everywhere will find a valuable aid in approaching this important subject or rapidly reviewing it. The book is a guide not only to roentgen procedure, but gives succinctly the fundamental features underlying the various abnormalities and diseases of the alimentary system.

Much of the text is in outline form, which is in accord with the author's statement that he has intended the work as a manual rather than a reference book. He has used as a basis the topographic and etiologic classification of the "Standard Nomenclature of Disease," and under each of the pertinent headings has outlined and discussed briefly the characteristic changes in contour, motility, and position which furnish a clue to diagnosis.

The book is well made and amply illustrated with reproductions of photographs and roentgenograms. The liberal use of boldface and italic type is appropriate in a manual of this type.

EXPERIMENTS WITH MAMMALIAN SARCOMA EXTRACTS IN REGARD TO CELL-FREE TRANSMISSION AND INDUCED TUMOR IMMUNITY: FURTHER STUDIES OF THE KREBS, RASK-NIELSEN, WAGNER SARCOMA. By CARL KREBS, OSKAR THORDARSON, AND JOHANNES HARBO. Supplementum XLIV to *Acta Radiologica*. A volume of 96 pages. The Hafnia Printing House, Aarhus, Denmark, 1942.

In 1930 Krebs, Rask-Nielsen, and Wagner published an account of a transmissible lymphosarcoma in white mice (Supplementum X to *Acta Radiologica*. Reviewed in *RADIOLOGY* 16: 534, 1931). Krebs, Thordarson, and Harbo have continued the investigation of this tumor in an attempt to determine (1) whether it is caused by a virus and, under

suitable conditions, is transmissible by cell-free material, and (2) whether resistance to transmission can be culcated by injection of tumor extracts.

The attempts to prove the existence of a virus or cell-free agent included experiments with absolutely cell-free materials and with tumor material that had been subject either to autolysis, irradiation, or dehydration and mincing. From their observations the authors obtained no evidence in support of a virus origin for the tumor. It is true that transmission was successful in a few instances following irradiation of the injected tumor material with large roentgen doses, but this is attributed to surviving cells.

The experiments on the effect of injected cell-free tumor material on resistance to inoculation are still in progress, and the authors state that on this point the present communication is to be regarded only as a preliminary report. "From the results of the experiments made, it must be considered as overwhelmingly probable that the resistance of the mice against transmission of the tumor can be measurably increased by treatment with extractive substances from the tumor."

A bibliography is appended, and, what is rather unusual in the supplements to *Acta Radiologica*, an index.

RADIOTHERAPY IN ACTINOMYCOSIS. By EIVIND STOKKELAND. Supplementum L to *Acta Radiologica*. A volume of 53 pages, with 4 illustrations. Fabritius & Sonners, Oslo, 1943.

This monograph on the radiotherapy of actinomycosis comes from the Norwegian Radium Hospital. In an introductory chapter the author reviews briefly the etiology and pathology of actinomycosis, cites the results of irradiation in several clinics, and discusses in a general way the technic and dosage employed. His own material of 33 cases he classifies on the basis of regional distribution, as follows:

Cervico-facial types.....	25 cases
Abdominal types.....	8 cases
Thoracic types.....	1 case
Other types.....	1 case (extremity)

Several methods of treatment are cited. Some are discussed at considerable length. In the present series both radium and roentgen rays were used. Fractional roentgen therapy, now considered the treatment of choice, was most frequently employed, with a daily dose of 50 to 200 r, though in some instances daily doses of 300 r were given. The total dose per field was 1,750 to 3,000 r, a single field being the general rule. In 4 cases a single series sufficed, but in other cases the series was repeated at intervals of four weeks to four months.

All of the patients with disease of the cervico-facial type were cured. Of the 8 patients with abdominal disease, 4 were cured, 2 were improved,

2 were still under treatment at the time of the report. The patient with thoracic disease died. In the remaining case, in which an extremity was involved, roentgen therapy was supplemented by amputation, with lasting recovery.

UNTERSUCHUNGEN ÜBER DIE RÖNTGENNAHBESTRAHLUNG. EINE STUDIE ÜBER PHYSIKALISCHE LEISTUNGEN UND KLINISCHE ERGEBNISSE MIT DEM PHILIPS METALIX - NABSTRAHL - THERAPIE-APPARAT. By SVEN HULTBERG. Supplementum LIV to *Acta Radiologica*. A volume of 219 pages, with 63 illustrations. Published by Hakan Ohlssons Boktryckeri, Lund, 1943.

This monograph on contact therapy, from the Radiologic Clinic in Lund, opens with an historical survey of the method and a description of the Philips-Metalix apparatus used in that institution since 1940. The results of physical measurement of the rays are also presented. The subsequent chapters deal with skin cancer, cancer of the lip, precancerous hyperkeratosis and leukoplakia, warts, hemangiomas, keloids, and a number of isolated examples of cancer of the oral cavity, penis, etc. High percentages of cures are reported after follow-up periods of a few months to three years.

A series of tables presents concisely the case histories, and 63 figures are included, chiefly before-and-after views of cases treated.

A smaller group of cases, presumably included in the present series, was reported by the author in *Acta Radiologica* 24: 328, 1943 (Abst. in *RADIOLOGY* 45: 642, 1945).

STUDIEN ÜBER DIE KUMULATIVE WIRKUNG DER RÖNTGENSTRAHLEN BEI FRAKTIONIERUNG. ERFAHRUNGEN AUS DEM RADIUMHEMMET AN 280 HAUT- UND LIPPENKARZINOMEN. By MAGNUS STRANDQVIST. Supplementum LV to *Acta Radiologica*. A volume of 300 pages, with 18 plates containing 111 illustrations. Published by P. A. Norstedt & Söner, Stockholm, 1944.

This monograph from the Radiumhemmet, Stockholm, is written in German, with an English summary of several pages. It is based on a study of 183 cases of basal-cell and 74 cases of squamous-cell carcinoma of the skin and 23 carcinomas of the lip. The clinical picture, technic of treatment, dosage, and results in each case are presented in a table of 46 pages. From his observations in this series the author seeks to analyze the correlation between the

total roentgen dose and total treatment period in cases with similar biologic effects following daily divided doses. He presents his own fractionation curve and compares his fractionation factors with values obtained by other workers, notably Reisner of Germany and Quimby in America. It is repeatedly stressed that the main purpose of the study is not to establish definite figures, but to present working methods with the help of which future investigations may yield a better understanding of fractionation curves for various objects.

THE RADIOSENSITIVITY OF BONE MARROW. By TORFINN DENSTAD. Supplementum LII to *Acta Radiologica*. A volume of 176 pages, with 9 diagrams, 11 photomicrographs, and 8 tables. Printed in Norway by Centraltrykkeriet, Oslo, 1943.

The reaction of the bone marrow to radiation is of significance, as the author of this monograph states, from several standpoints, notably the treatment of such diseases as myelogenous leukemia and polycythemia, a better understanding of the leukopenia frequently observed following even small doses of radium and x-rays, and the question of lasting injury to the marrow and its bearing on the diagnostic value of subsequent sternal puncture.

The present study is based on a series of 125 patients receiving radiotherapy, chiefly for malignant neoplasms and lymphogranulomatosis in a number of different institutions. It embraces both the indirect effects on the unirradiated marrow and the direct effects. As to the indirect effects, the author concludes that irradiation, whether with x-rays or radium, in cancericidal doses, produces no morphological changes in the non-irradiated marrow in patients without granulocytopenia. Where the radiation causes granulocytopenia, however, a mild degree of maturation inhibition of myelopoiesis was observed, while there appeared to be some stimulation of erythropoiesis. To direct irradiation the cells of the bone marrow proved highly radiosensitive, the erythroblasts slightly more than the myeloid cells. Within each series of cells, the youngest form were the first to disappear, while the older ones disappeared with increasing doses. Regeneration was good, the erythroblasts regenerating first and the myeloid cells somewhat later.

The author includes an account of earlier investigations on this problem, with a bibliography of several pages.

RADIOLOGICAL SOCIETIES OF NORTH AMERICA

Editor's Note.—Will secretaries of societies please cooperate by sending information to Howard P. Doub, M.D., Editor, Henry Ford Hospital, Detroit 2, Mich.

UNITED STATES

Radiological Society of North America.—Secretary, D. S. Childs, M.D., 607 Medical Arts Bldg., Syracuse 2, N.Y.

American Roentgen Ray Society.—Secretary, Harold Dabney Kerr, M.D., Iowa City, Iowa.

American College of Radiology.—Secretary, Mac F. Cahal, 20 N. Wacker Dr., Chicago 6, Ill.

Section on Radiology, American Medical Association.—Secretary, U. V. Portmann, M.D., Cleveland Clinic, Cleveland 6, Ohio.

ARKANSAS

Arkansas Radiological Society.—Secretary, J. S. Wilson, M.D., Monticello. Meets every three months and annually at meeting of State Medical Society.

CALIFORNIA

California Medical Association, Section on Radiology.—Secretary, Gordon King, M.D., Children's Hospital, San Francisco.

Los Angeles County Medical Association, Radiological Section.—Secretary, Roy W. Johnson, M.D., 1407 South Hope St., Los Angeles. Meets second Wednesday of each month at County Society Building.

Pacific Roentgen Society.—Secretary, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually with California Medical Association.

San Diego Roentgen Society.—Secretary, R. F. Niehaus, M.D., 1831 Fourth Ave., San Diego, Calif. Meets first Wednesday of each month.

San Francisco Radiological Society.—Secretary, Joseph Levitin, M.D., 516 Sutter St., San Francisco 2. Meets monthly on the third Thursday at 7:45 P.M., first six months of the year in Lane Hall, Stanford University Hospital, and second six months in Toland Hall, University of California Hospital.

COLORADO

Denver Radiological Club.—Secretary, A. Page Jackson, Jr., M.D., 304 Republic Bldg., Denver 2. Meetings third Friday of each month, Denver Athletic Club.

CONNECTICUT

Connecticut State Medical Society, Section on Radiology.—Secretary, Max Climan, M.D., 242 Trumbull St., Hartford 3. Meetings bimonthly, second Thursday.

FLORIDA

Florida Radiological Society.—Secretary-Treasurer, J. F. Pitman, M.D., Blanche Hotel Annex, Lake City.

GEORGIA

Georgia Radiological Society.—Secretary-Treasurer, James J. Clark, M.D., 478 Peachtree St., N. E., Atlanta 3. Meets in November and at the annual meeting of State Medical Association.

ILLINOIS

Chicago Roentgen Society.—Secretary, Fay H. Squire, M.D., 1753 W. Congress St., Chicago 12. Meets at the Palmer House, second Thursday of October, November, January, February, March, and April.

Illinois Radiological Society.—Secretary-Treasurer, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly by announcement.

Illinois State Medical Society, Section on Radiology.—Secretary, Frank S. Hussey, M.D., 250 East Superior St., Chicago 11.

INDIANA

The Indiana Roentgen Society.—Secretary-Treasurer, Harold C. Oelsner, M.D., Methodist Hospital, Indianapolis 7. Annual meeting in May.

IOWA

The Iowa X-ray Club.—Secretary, Arthur W. Erskine, M.D., 326 Higley Building, Cedar Rapids. Meets during annual session of Iowa State Medical Society.

KENTUCKY

Kentucky Radiological Society.—Secretary-Treasurer, Sydney E. Johnson, M.D., 101 W. Chestnut St., Louisville.

LOUISIANA

Louisiana Radiological Society.—Secretary-Treasurer, Johnson R. Anderson, M.D., North Louisiana Sanitarium, Shreveport. Meets annually at same time as State Medical Society.

Orleans Parish Radiological Society.—Secretary, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets first Tuesday of each month.

Shreveport Radiological Club.—Secretary, Oscar O. Jones, M.D., 2622 Greenwood Road. Meets monthly September to May, third Wednesday, 7:30 P.M.

MARYLAND

Baltimore City Medical Society, Radiological Section.—Secretary, Charles N. Davidson, M.D., 101 West Read St., Baltimore 1.

MICHIGAN

Detroit X-ray and Radium Society.—Secretary-Treasurer, E. R. Witwer, M.D., Harper Hospital, Detroit 1. Meetings first Thursday of each month from October to May, at Wayne County Medical Society club rooms.

MINNESOTA

Minnesota Radiological Society.—Secretary, A. T. Stenstrom, M.D., Minneapolis General Hospital, Minneapolis 26. Meetings quarterly.

MISSOURI

Radiological Society of Greater Kansas City.—Secretary, John W. Walker, M.D., 306 E. 12th St., Kansas City, Mo. Meetings last Friday of each month.

St. Louis Society of Radiologists.—Secretary, Edwin C. Ernst, M.D., 100 Beaumont Medical Bldg. Meets on fourth Wednesday of each month, October to May.

NEBRASKA

Nebraska Radiological Society.—Secretary-Treasurer, Donald H. Brcit, M.D., University of Nebraska Hospital, Omaha 5. Meetings third Wednesday of each month at 6 P.M. in either Omaha or Lincoln.

NEW ENGLAND

New England Roentgen Ray Society.—Secretary-Treasurer, George Levene, M.D., Massachusetts Memorial

Hospitals, Boston, Mass. Meets monthly on third Friday at Boston Medical Library.

NEW HAMPSHIRE

New Hampshire Roentgen Society.—Secretary-Treasurer, Richard C. Batt, M.D., St. Louis Hospital, Berlin.

NEW JERSEY

Radiological Society of New Jersey.—Secretary, H. R. Brindle, M.D., 501 Grand Ave., Asbury Park. Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called.

NEW YORK

Associated Radiologists of New York, Inc.—Secretary, William J. Francis, M.D., East Rockaway, L. I.

Brooklyn Roentgen Ray Society.—Secretary-Treasurer, Leo A. Harrington, M.D., 880 Ocean Ave., Brooklyn 26. Meets fourth Tuesday of every month, October to April.

Buffalo Radiological Society.—Secretary-Treasurer, Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meetings second Monday evening each month, October to May, inclusive.

Central New York Roentgen Society.—Secretary-Treasurer, Carlton F. Potter, M.D., 425 Waverly Ave., Syracuse 10. Meetings in January, May, and October.

Long Island Radiological Society.—Secretary, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meetings fourth Thursday evening each month at Kings County Medical Bldg.

New York Roentgen Society.—Secretary, Wm. Snow, M.D., 941 Park Ave., New York 28.

Rochester Roentgen-Ray Society.—Secretary, Murray P. George, M.D., 260 Crittenden Blvd., Rochester 7. Meets at Strong Memorial Hospital, third Monday, September through May.

NORTH CAROLINA

Radiological Society of North Carolina.—Secretary-Treasurer, Major I. Fleming, M.D., 404 Falls Road, Rocky Mount. Meets in May and October.

NORTH DAKOTA

North Dakota Radiological Society.—Secretary, Charles Heilman, M.D., 1338 Second St., N., Fargo.

OHIO

Ohio Radiological Society.—Secretary, Henry Snow, M.D., 1061 Reibold Bldg., Dayton 2. Next meeting at annual meeting of the Ohio State Medical Association.

Cleveland Radiological Society.—Secretary-Treasurer, Carroll C. Dundon, M.D., 11311 Shaker Blvd., Cleveland 4. Meetings at 6:30 P.M. on fourth Monday of each month from October to April, inclusive.

Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists).—Secretary-Treasurer, Samuel Brown, M.D., 707 Race St., Cincinnati 2. Meetings held third Tuesday of each month.

PENNSYLVANIA

Pennsylvania Radiological Society.—Secretary-Treasurer, L. E. Wurster, M.D., 416 Pine St., Williamsport 8. The Society meets annually.

Philadelphia Roentgen Ray Society.—Secretary, Calvin L. Stewart, M.D., Jefferson Hospital, Philadelphia 7. Meets first Thursday of each month at 8:00 P.M., from October to May in Thomson Hall, College of Physicians, 21 S. 22d St.

Pittsburgh Roentgen Society.—Secretary-Treasurer, Lester M. J. Freedman, M.D., 4800 Friendship Ave., Pittsburgh 24. Meets second Wednesday of each month at 6:30 P.M., October to May, inclusive, at The Ruskin, 120 Ruskin Ave.

ROCKY MOUNTAIN STATES

Rocky Mountain Radiological Society (North Dakota, South Dakota, Nebraska, Kansas, Texas, Wyoming, Montana, Colorado, Idaho, Utah, New Mexico).—Secretary, A. M. Popma, M.D., 220 North First St., Boise, Idaho.

SOUTH CAROLINA

South Carolina X-ray Society.—Secretary-Treasurer, Robert B. Taft, M.D., 103 Rutledge Ave., Charleston 16.

TENNESSEE

Memphis Roentgen Club.—Chairmanship rotates monthly in alphabetical order. Meetings second Tuesday of each month at University Center.

Tennessee Radiological Society.—Secretary-Treasurer, J. Marsh Frère, M.D., 707 Walnut St., Chattanooga. Meets annually with State Medical Society in April.

TEXAS

Dallas-Fort Worth Roentgen Study Club.—Secretary, X. R. Hyde, M.D., Medical Arts Bldg., Fort Worth 2. Meetings on third Monday of each month, in Dallas in the odd months and in Fort Worth in the even months.

Texas Radiological Society.—Secretary-Treasurer, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth 4.

VIRGINIA

Virginia Radiological Society.—Secretary, E. Latta Flanagan, M.D., 215 Medical Arts Bldg., Richmond 19.

WASHINGTON

Washington State Radiological Society.—Secretary-Treasurer, Thomas Carlile, M.D., 1115 Terry Ave., Seattle. Meetings fourth Monday of each month, October through May, at College Club, Seattle.

WISCONSIN

Milwaukee Roentgen Ray Society.—Secretary-Treasurer, C. A. H. Fortier, M.D., 231 W. Wisconsin Ave., Milwaukee 3. Meets monthly on second Monday at the University Club.

Radiological Section of the Wisconsin State Medical Society.—Secretary, S. R. Beatty, M.D., 185 Hazel St., Oshkosh. Two-day annual meeting in May and one day in connection with annual meeting of State Medical Society in September.

University of Wisconsin Radiological Conference.—Meets first and third Thursdays 4 to 5 P.M., September to May, inclusive, Room 301, Service Memorial Institute, 426 N. Charter St., Madison 6.

CANADA

Canadian Association of Radiologists.—Honorary Secretary-Treasurer, J. W. McKay, M.D., 1620 Cedar Ave., Montreal.

La Société Canadienne-Française d'Electrologie et de Radiologie Médicales.—General Secretary, Origène Dufresne, M.D., Institut du Radium, Montreal. Meets on third Saturday of each month.

CUBA

Sociedad de Radiología y Fisioterapia de Cuba.—Office in Hospital Mercedes, Havana. Meets monthly.

ABSTRACTS OF CURRENT LITERATURE

ROENTGEN DIAGNOSIS

The Head and Neck

- McGRIGOR, D. B., AND SAMUEL, ERIC. Radiology of War Injuries. Part IV. War Wounds of the Head and Neck..... 531
- WELIN, SÖLVE. On the Roentgen Diagnosis of Cholesteatoma in the Temporal Bone..... 531
- HOLM, OLOF FR. Cinematography in Cerebral Angiography..... 531

The Chest

- FIGI, FREDERICK A., BRODERS, ALBERT C., AND HAVENS, FRED Z. Plasma Cell Tumors of the Upper Part of the Respiratory Tract... 532
- DORMER, B. A., FRIEDLANDER, J., AND WILES, F. J. Bronchography in Pulmonary Tuberculosis: Artificial Pneumothorax..... 532
- BASS, H. E., AND THOMPSON, G. D. CARLYLE. Incidence of Tuberculosis in Japanese-Americans: A Study of a Homogeneous Racial Group..... 532
- FERKANAY, JOSEPH E., AND LEE, RICHARD K. C. Tuberculosis Survey of Food Handlers on the Island of Oahu..... 533
- WILLIS, R. A., AND ROSENTHAL, D. B. Incidence of Extrapulmonary Tuberculous Infection in Fatal Pulmonary Tuberculosis..... 533
- SELBY, C. D. Attitude of Industry Toward X-Ray Examinations of the Chest..... 533
- WALDENSTRÖM, JAN. Relapsing, Diffuse, Pulmonary Bleedings or Hemosiderosis Pulmonum—A New Clinical Diagnosis..... 533
- ENZER, NORBERT, SIMONSON, ERNST, AND EVANS, A. M. Clinical Physiological Observations on Welders with Pulmonary Siderosis and Foundry Men with Nodular Uncomplicated Silicosis..... 534
- PEIRCE, CARLETON B., CRUTCHLOW, EVERETT F., HENDERSON, ARTHUR T., AND MCKAY, JOSEPH W. Transient Focal Pulmonary Edema..... 534
- LEOPOLD, JEROME S., AND KRATZMAN, EMIL A. Obstructive Pulmonary Emphysema Associated with Pneumonia in Childhood..... 534
- ROSEMOND, G. P., AND CASWELL, H. T. Pyopneumothorax in the First Month of Life with Recovery. Two Case Reports..... 534
- HAMPTON, AUBREY O., PRANDONI, ANDREW G., AND KING, JOHN T. Pulmonary Embolism from Obscure Sources..... 534
- WALDMAN, SAMUEL. Transient Heart Block in Congenital Heart Disease..... 535
- SHAPIRO, ROBERT. Intracardiac Foreign Body. Report of Case with Recovery..... 535
- BENNER, SVEN, KJELLBERG, SVEN R., AND SjöSTRAND, TORGNY. On the Possibility of

- Studying the Function of the Heart with the Aid of Roentgen-Cinematography. Roentgen Cinematography Combined with Electric Recordings of the Resistance of the Cardiac Valves..... 536
- LAHEY, FRANK H. Intrathoracic Goiters..... 536

The Digestive System

- SMITHERS, D. W. Short Esophagus (Thoracic Stomach) and Its Association with Peptic Ulceration and Cancer..... 536
- VIDEBÆK, AAGE. Singular Case of the Plummer-Vinson Syndrome..... 536
- HAMILTON, JOHN B. Gastric Volvulus and Other Abnormal Rotations of the Stomach..... 537
- MILLER, RUSSEL F., AND OSTRUM, HERMAN W. Hypertrophic Pyloric Stenosis in Infants: Roentgenologic Differential Diagnosis..... 537
- FRIEDMAN, NATHAN B. Cellular Dynamics in the Intestinal Mucosa: Effect of Irradiation on Epithelial Maturation and Migration..... 537
- MURBACH, C. F., LEWISON, E. F., AND DEIBERT, G. A. Lymphangioma of the Abdomen. An Unusual Case..... 538
- POLGÁR, F. Nursing—A Source of Error in Cholecystography..... 538

The Musculoskeletal System

- CAFFEY, JOHN, AND SILVERMAN, WILLIAM A. Infantile Cortical Hyperostoses: Preliminary Report on a New Syndrome..... 538
- DUNHAM, ETHEL C., AND THOMS, HERBERT. Effects of Severe Rickets in Early Childhood on Skeletal Development in Adolescence..... 539
- HOWORTH, M. BECKETT. Echinococcosis of Bone. 539
- MAYER, J. H. Chronic Melioidosis. Case Showing Multiple Lesions of Bones, Joints and Lungs..... 539
- LANDOFF, G. A. Osteomyelosclerosis..... 540
- LINDBLOM, K. Protrusions of Disks and Nerve Compression in the Lumbar Region..... 540
- CRYSLER, W. E., AND MORTON, H. S. Osteochondritis Dissecans of the Supratrochlear Septum of the Humerus..... 540
- HARE, HUGH F., AND HAGGART, G. EDMUND. Osteitis Condensans Ilii..... 540
- MCMASTER, PAUL E. Epiphysitis of the Ischial Tuberosity: Case Report..... 540
- MCGAW, W. H., AND WECKESSER, E. C. Pneumarthrograms of the Knee. A Diagnostic Aid in Internal Derangements..... 540
- SIMON, R. S. A Third Routine X-Ray Exposure of the Ankle Joint..... 541
- EVANS, E. MERVYN. Rotational Deformity in the Treatment of Fractures of Both Bones of the Forearm..... 541
- KNEPPER, PAUL A. Parachute Fractures..... 541
- RONALD A. Fatigue Fracture..... 541

The Genito-Urinary System

- WALLDÉN, LENNART. Administration of Contrast Medium in Urography via the Bone Marrow. 541
- LINDBOM, ÅKE. Miliary Tuberculosis after Retrograde Pyelography. Report of Case.. 541
- GOYANNA, RUY, AND GREENE, LAURENCE F. Pathologic and Anomalous Conditions Associated with Duplication of the Renal Pelvis and Ureter..... 541
- NORFLEET, CHARLES M., JR. Bilateral Crossed Renal Ectopia: Case Report..... 542
- LEVINE, BERNARD. Aneurysm of the Renal Artery..... 542

RADIOTHERAPY

- MARTIN, HAYES, AND REESE, ALGERNON B. Treatment of Bilateral Retinoblastoma (Retinal Glioma) Surgically and by Irradiation... 542
- LEVI, LEO M. Response to Preoperative Irradiation as a Clue to the Management of Breast Cancer..... 542
- HARE, HUGH F. Present Status of Diagnosis and Treatment of Uterine Carcinoma..... 543
- LÜBSCHITZ, KAREN. Paget's Disease on the Nipple with Special Reference to Its Course and Treatment..... 543

- BUSCHKE, FRANZ, AND CANTRIL, SIMEON T. Irradiation Failures in Early Cervical Cancer. Improved Irradiation or Return to Surgery?. 543
- GOLDMAN, LEONARD B., AND VICTOR, ABRAHAM W. Hodgkin's Disease. Salient Clinical Features and Relative Value of Various Methods of Treatment Based upon Study of 319 Cases..... 544
- WARREN, SHIELDS. Therapeutic Use of Radioactive Phosphorus..... 545
- HALL, BYRON E., WATKINS, CHARLES H., HARGRAVES, MALCOLM M., AND GIFFIN, HERBERT Z. Radioactive Phosphorus in the Treatment of Polycythemia Vera. Results and Hematologic Complications..... 545
- KAPLAN, IRA I. Roentgen Therapy of Arthritides..... 546

Technic and Dosage

- JENSEN, SV. HOFFER, NIELSEN, JENS, AND THAYSEN, V. Evaluation of Different Factors in Rotation Therapy..... 546
- WISSENBERG, PAULA. Dose Distribution in Rotary Irradiation of Eccentrically Situated Axial Field as Basis for Experiments with Rotation Treatment of Cancer of the Rectum. 546
- RUDINGER, G. A Slide Rule for Determination of Dosage from Linear Radium Applicators.... 546



ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Radiology of War Injuries. Part IV. War Wounds of the Head and Neck. D. B. McGrigor and Eric Samuel. *Brit. J. Radiol.* 18: 221-228, July 1945.

Injuries of the head and neck constitute about 11 per cent of war wounds: 50 per cent involve the vault of the skull and 50 per cent the face and neck.

Radiological reports of injuries of the cranium should describe the site of the fracture, its size, its type, and any involvement of vascular channels. There is no simple comprehensive technic for investigation of injuries of the head and neck. The type of examination is determined by the injury. In the majority of cases an anteroposterior view and a lateral view in the brow-up position, including the mandible, are sufficient. For penetrating wounds of the orbit and frontal sinuses a postero-anterior projection is necessary. Injuries of the facial bones require stereoscopic occipitomental views, lateral views of the facial bones, occlusal and dental views of the nose, and lateral views of both mandibles. Tomography is often of great value.

Injuries caused by missiles are of varying degrees of severity. Only the outer table may be injured, or there may be through-and-through penetration with varying degrees of inward displacement of bone fragments. Elevated fractures may occur at the wound of exit.

The demonstration of intracranial air is of the utmost importance. When air appears over the surface of the brain (in the sulci), special attention should be given to the air sinuses for evidence of fracture.

In wounds of the neck radiology is used chiefly in the location of foreign bodies. Wounds of the larynx and trachea may give rise to extensive subcutaneous emphysema.

Fractures involving the facial bones frequently involve the nasal accessory sinuses.

SYDNEY J. HAWLEY, M.D.

On the Roentgen Diagnosis of Cholesteatoma in the Temporal Bone. Solve Welin. *Acta radiol.* 25: 227-239, June 30, 1944. (In English.)

The roentgen diagnosis of cholesteatoma is based on its bone-destroying effects. The sharp definition, angularity, and polygonal shape of cholesteatoma cavities, their occurrence in temporal bones with reduced pneumatization, and a linear calcareous zone between them and the surrounding bone tissue have been held to be characteristic features.

The author's material consisted of 109 cases, of which 5 were bilateral. He has divided them according to localization into three groups, cholesteatoma (1) in the aditus ad antrum, (2) in the antrum, and (3) in the attic.

(1) The most common and most important roentgenologic indication of cholesteatoma, according to the author, is pathological enlargement of the aditus ad antrum. The aditus was enlarged in 68 of his cases. The change may be very slight, or the inner portion of the posterior wall of the auditory canal may be almost completely destroyed.

(2) Roentgenologically a distinction is made between cholesteatoma in non-pneumatized temporal bones and in pneumatized temporal bones. In the

first named, a diagnosis cannot as a rule be made by roentgen examination except in the presence of rather extensive destruction unless there is also a pathological enlargement of the aditus. Nor is the diagnosis easy in pneumatized temporal bone. Even large areas of destruction may be difficult to differentiate from an abscess cavity unless the aditus is enlarged.

(3) The author's material included 28 cases of cholesteatoma in the attic, of which 15 produced changes visible in the roentgenogram. The roentgenologic changes differ with the localization of the area of destruction in the epitympanic recess. With destruction in the lateral wall, there is a well defined spike-like or rounded defect in the lower margin of the attic. In cases of cholesteatoma developing posteriorly toward the aditus, the latter may become enlarged. Finally, cholesteatomata may develop upward toward the roof of the middle fossa of the skull and produce destruction there, manifested in the axial view by a distinctly circumscribed thinning in the region of the tympanum.

JOSEPH H. WEISS, M.D.

Cinematography in Cerebral Angiography. Olov Fr. Holm. *Acta radiol.* 25: 163-173, June 30, 1944. (In English.)

A brief review of the literature on the development of roentgen cinematography is given, followed by a description of the apparatus and method used in cerebral angiography in the Serafimer Hospital (Stockholm). For these the original paper must be consulted.

Thorotrast and perabrodil are the contrast media used. A schematic plexiglass model was constructed of the cerebral vascular system to study the behavior of the contrast media in a vascular system. This seemed to approximate the behavior in man. The total time for passage from the internal carotid artery to the jugular vein is 3.25 seconds. With cerebral angiography as ordinarily practised, as many as six roentgen exposures can be made, but not even this number is sufficient to demonstrate the entire course of the medium. This can only be done cinematographically.

It is in cases of arteriovenous aneurysm and malignant glioma that the cinematographic method is of particular value. In the presence of arteriovenous aneurysm the passage of the medium is so rapid that there is a danger that in ordinary angiography the first exposure may be made too late. With cinematography the medium can be seen directly as it enters the afferent vessel and a reliable record is obtained of the whole phase, which is of great importance in planning the operative procedure. In malignant glioma, the examiner can follow the course of the contrast medium through the pathologic vessels and can thus form an opinion of their extent.

Less contrast material is required for cinematography than for ordinary roentgenography, and this is an added advantage, especially when thorotrast is used.

On the basis of his experience, the author reaches the following conclusion: "Cinematography of cerebral angiography theoretically is superior to ordinary roentgenography. As a rule it gives a definite diagnosis, and in many cases it has contributed to or verified a diagnosis considered uncertain on the basis of ordinary photography. With the technical resources now at our disposition, however, the time is not yet

ripe to replace the older method with the newer one; instead the two should be used to complement each other."

JOSEPH H. WEISS, M.D

THE CHEST

Plasma Cell Tumors of the Upper Part of the Respiratory Tract. Frederick A. Figi, Albert C. Broders, and Fred Z. Havens. *Ann. Otol., Rhin., & Laryng.* 54: 283-297, June 1945.

This report is based on a study of 11 cases of solitary plasma-cell myelomas, or plasmocytomas, of the upper part of the respiratory tract observed at the Mayo Clinic in a period of fourteen years. Seven of the patients were males and 4 females; the age range was thirty-seven to seventy-one years.

Plasmocytomas may arise in any portion of the upper respiratory tract. In the present series the site was as follows: the maxillary sinus in 6 cases; the oropharynx in 2 cases; the nasopharynx in 2 cases; and the larynx in the remaining case. In most instances there is a history of symptoms for less than six months, but they may have been present for a year or more. The most common complaints are swelling of the cheek, nasal obstruction, and frontal headache. Where the condition is primary in the mouth or pharynx, the patients are aware of the presence of a tumor, and some of them experience dysphagia.

The general appearance of the patients in this series varied with the stage of the disease. Some were in good general health and showed no evidence of systemic effects of the neoplasm. Others had the cachexia, anemia, weakness, and disability usually associated with an advanced malignant tumor.

Examination generally has revealed a tumor that appeared highly malignant. In all of the cases with primary involvement of the maxillary sinus, the findings were indicative of malignancy. Bulging of the palate, alveolus, cheek, and lateral wall of the nose, complete density of the maxillary sinus on transillumination, and elevation and, at times, proptosis of the eye were present. Clinical evidence of involvement of regional lymph nodes was noted only once in this series. In that case, the tumor, which originated in the right tonsil, had an ulcerated polypoid appearance. It measured 3 X 2.5 cm., while the metastatic growth in the right cervical region was 4 cm. in diameter.

Roentgenographic studies of the bony structures of the involved region and of the thorax were made in all the authors' cases. Where the neoplasm involved the accessory sinuses, roentgenographic examination frequently showed much more extensive involvement than was suspected clinically. In several instances, a tumor that appeared clinically to involve only the maxillary sinus and nasal fossa was found by roentgenographic examination to be present in the ethmoid cells and frontal sinus as well. In this group, too, malignant destruction of the floor and walls of the maxillary sinus, ethmoid cells, orbit, nose, and zygoma at times was evident. In one case where a non-ulcerated tumor protruded from the vault of the nasopharynx, roentgenograms showed extensive destruction of the sella turcica and cloudiness of the sphenoid sinus, which revealed either of these regions as the site of origin of the neoplasm. Roentgenograms of the thorax were normal in all of the patients at the original examination at the Clinic.

In only one of the 11 cases was metastatic involvement of bone demonstrable roentgenographically at the time of the primary examination. This patient had a huge, rapidly recurring tumor of the upper jaw, maxillary sinus and ethmoid cells, with what appeared to be multiple areas of metastatic destruction throughout the skull as well. There were no symptoms referable to the secondary tumors.

Unquestionably, this type of tumor is rare. The 2 plasma-cell tumors encountered in the pharynx occurred among approximately 360 malignant neoplasms in that region; the 2 in the nasopharynx were found among more than 300 malignant growths in that situation. Approximately 625 cases of malignant growths of the nose and accessory sinuses were observed during the fourteen years covered by this report. Yet among these, only 6 cases of plasma-cell myeloma were discovered. The single laryngeal tumor was one of more than 1,600 malignant neoplasms of the larynx.

The authors cannot agree that plasmocytomas may be of inflammatory origin. Some of their series were fulminating malignant tumors and others only mildly malignant, but all were true neoplasms. Microscopically, the neoplastic plasma cells are usually diffusely massed like the cells of a lymphosarcoma. A single-file effect comparable to the cells of certain carcinomas of the breast and the stomach may be presented. That any of these tumors were granulomatous or inflammatory was not remotely suggested.

STEPHEN N. TAGER, M.D.

Bronchography in Pulmonary Tuberculosis: Artificial Pneumothorax. B. A. Dörner, J. Friedlander, and F. J. Wiles. *Am. Rev. Tuberc.* 52: 21-35, July 1945.

The effect on the lungs of artificial pneumothorax has been studied by means of bronchography and 11 cases are described and illustrated. The authors have emphasized in previous articles the importance of bronchial and bronchiolar obstruction in pulmonary tuberculosis. Bronchographic studies indicate that the reason artificial pneumothorax can be a successful method of treatment is because it tends to eliminate such bronchial obstruction. Artificial pneumothorax causes peripheral collapse. The general retraction and shrinking of alveoli and connective tissue prevent further infection and tend to squeeze liquefied tuberculous material out of the blocked bronchioles, leaving them patent. This allows healing by fibrosis. If bronchial block persists in spite of pneumothorax, the procedure will have no therapeutic value. The development of lobar atelectasis following the induction of pneumothorax is an indication for quickly abandoning the procedure if normal relationships cannot be established otherwise.

L. W. PAUL, M.D.

Incidence of Tuberculosis in Japanese-Americans: A Study of a Homogeneous Racial Group. H. E. Bass and G. D. Carlyle Thompson. *Am. Rev. Tuberc.* 51: 46-50, July 1945.

A study of the incidence of tuberculosis in a homogeneous racial group of Japanese-Americans is presented. Reactors to the tuberculin test were studied by fluoroscopy, with subsequent roentgenograms when needed. Of a total of 2,771 persons receiving tuberculin tests, 1,233 (45 per cent) were positive. The incidence of tuberculosis was 3.69 per cent—45 cases, of

which 5 were classified as active, 32 as arrested, and 8 as apparently cured. The findings indicate that the incidence of pulmonary tuberculosis in this group is no higher than that of similar groups of native Americans from the same geographic area. L. W. PAUL, M.D.

Tuberculosis Survey of Food Handlers on the Island of Oahu. Joseph E. Ferkauf and Richard K. C. Lee. *Am. Rev. Tuberc.* 52: 51-57, July 1945.

Beginning in August 1943, the health department regulations in the Territory of Hawaii were amended to require an x-ray examination of the chest of all food handlers. The present report details the findings in 10,000 food handlers who were studied by means of 4 X 5-inch fluorograms supplemented by standard roentgenograms when indicated. Altogether 537 persons had suspicious or characteristic lesions of tuberculosis, necessitating further x-ray and epidemiological study. Of these, 314 (3.14 per cent) were considered to have characteristic lesions, with 80 persons (0.8 per cent) having active tuberculous disease. The majority of cases discovered were in the minimal and moderately advanced stages. L. W. PAUL, M.D.

Incidence of Extrapulmonary Tuberculous Infection in Fatal Pulmonary Tuberculosis. R. A. Willis and D. B. Rosenthal. *M. J. Australia* 2: 39-42, July 14, 1945.

The authors tabulate the visceral lesions demonstrated at autopsy in three series of patients dying of pulmonary tuberculosis. The extrapulmonary involvement in one series of 121 autopsies was as follows:

Intestine.....	52.0%
Ulcers, small intestine.....	52.0%
Perforated ulcers, small intestine.....	7.0%
Hyperplastic ileocecal tuberculosis.....	12.0%
Ulcers, large intestine.....	5.0%
Vermiform appendix affected.....	10.0%
Peritoneum (independent of intestine).....	2.5%
Liver.....	2.5%
Spleen.....	4.0%
Kidneys.....	9.0%
Adrenals.....	5.0%
Larynx and pharynx.....	22.0%
Meninges.....	2.5%
Pericardium.....	7.0%

The total incidence of extrapulmonary tuberculosis in this series was 68 per cent, which is almost identical with that in the other series reported, from different institutions. Microscopic studies of apparently normal viscera in a group of 50 autopsied cases indicate, however, that figures based solely on gross observations are too low. Actually, the incidence of extrapulmonary lesions in fatal pulmonary tuberculosis is approximately 90 per cent. Tuberculosis, therefore, should be regarded as a general disease with the most important localization in the lungs rather than as a purely pulmonary infection, and clinical search for extrapulmonary sites of involvement should be systematically carried out. PERCY J. DELANO, M.D.

Attitude of Industry Toward X-Ray Examinations of the Chest. C. D. Selby. *J. A. M. A.* 128: 630-632, June 30, 1945.

The author concludes that industry has no well defined attitude toward x-ray examinations of the chest.

Its position is influenced by the opinions of physicians who are accustomed to advise with management on medical affairs, and is, therefore, in reality the attitude of the medical profession.

In making x-ray chest service available to employees, industry wishes the relationships which necessarily result from case finding to be professionally ethical, suitable to the best interests of the employees, and in conformance with local public health regulations and practices.

In industry the diagnosis of pulmonary tuberculosis and other lesions of the thoracic organs is usually based on the interpretation of films and is necessarily tentative. No such diagnosis is complete until substantiated by clinical observation, which is the function of the patient's own physician. Nevertheless, the interpretation of the films should be supported by x-ray knowledge and experience.

In some plants the radiologist is responsible for the x-ray technic and the reading of all films, in others for the reading of films only, or for reading of films which are not obviously negative. The first plan is the most desirable, but not always the most practical; the other arrangements have proved effectual and workable.

Relapsing, Diffuse, Pulmonary Bleedings or Hemosiderosis Pulmonum—a New Clinical Diagnosis. Jan Waldenström. *Acta radiol.* 25: 149-162, April 1944. (In English.)

In 1921 Ecclen described the anatomical changes found in two cases showing extensive hemosiderosis of the lungs and referred to Virchow as the only author who had described similar changes. Two new cases are recorded here.

The exact pathogenesis of the condition is not yet clear. There is primarily a disturbance in pulmonary circulation, along with a "chlorotic" type of iron deficiency anemia, with bleeding per diapedesis. Extensive fibrosis occurs throughout the lung with accumulation of iron pigment primarily in the cellular elements of the alveoli. Hemosiderin is also present in the regional lymph nodes but not elsewhere in the body.

The patients are children or adolescents and the symptoms are dyspnea and coughing, sometimes with blood-tinged sputum or small coagula. Colicky pain in the abdomen is often present. Hemosiderin and so-called "heart failure" cells are not a constant finding in the sputa. There is an anemia of hypochromic type, markedly sensitive to iron treatment but showing a characteristic tendency to relapse after treatment is discontinued. Blood studies reveal some degree of hemolysis along with hyperregeneration (reticulocytosis).

The final diagnosis is made from the roentgen picture. There occurs in both lungs, rather symmetrically disposed, a widespread infiltration of reticular design. Diffuse mottling with very small opacities may be seen. The vessels are not so clearly visible as would be the case in pulmonary stasis. The apical fields remain relatively clear, the mid-lung fields showing greatest involvement, with smoky infiltration obscuring the cardiac borders. There are sometimes seen more extensive infiltrations obviously caused by atelectasis. The roentgen findings may disappear in part or entirely with the temporary clinical remissions.

The development of the pulmonary picture with alternating improvement and relapse is more characteristic than the picture at any definite stage. Only

a correlation with the clinical course and hematologic analysis will make the correct interpretation of the roentgen picture possible.

Several excellent reproductions of the typical roentgen findings are presented. VICTOR KREMENS, M.D.

Clinical Physiological Observations on Welders with Pulmonary Siderosis and Foundry Men with Nodular Uncomplicated Silicosis. Norbert Enzer, Ernst Simonson, and A. M. Evans. *J. Indust. Hyg. & Toxicol.* 27: 147-158, June 1945.

An investigation was undertaken to determine what degree, if any, of impairment of pulmonary function is associated with siderosis and silicosis and to what extent this affects working capacity. The studies were carried out in groups of normal subjects (varying from 8 to 100 for different functions), 15 patients with siderosis (deposition of iron in the lungs without fibrosis, but with roentgen findings similar to uncomplicated nodular silicosis), and 8 patients with silicosis (nodular and uncomplicated). No statistically significant difference between the normal group and the siderosis group was found in any function, while the silicosis group showed significant depression of vital capacity, maximum pulmonary ventilation, relative pulmonary reserve, and endurance in dynamic and static work. A far greater percentage of patients with silicosis than with siderosis showed an individually significant depression of functions compared to the normal limits. An arbitrary scoring system was employed, composed of the most significant tests, and coefficients were applied for appraisal of the complex working capacity. The total score expressed group differences and individual differences more significantly than any single functional test.

Transient Focal Pulmonary Edema. Carleton B. Peirce, Everett F. Crutchlow, Arthur T. Henderson, and Joseph W. McKay. *Am. Rev. Tuberc.* 52: 1-14, July 1945.

Eight cases of Löffler's syndrome are described and the literature on the subject is reviewed. By the uninitiated the roentgenologic manifestations may be confused with those of tuberculosis. The authors' cases, however, showed sufficient characteristics for their differentiation. The amorphous character of the shadows, the appearance of rapid migration from one part of the lung to another, and the transient nature of the densities were notable features. The distribution is not that commonly manifest in tuberculosis. In general, the texture of the individual radiographic shadow was that of a haze or cloud.

A potential allergic factor is strongly suggested in the literature and was true also in the authors' cases. It is their belief that these lesions represent focal areas of transient pulmonary edema, probably associated with an allergic state, rather than focal areas of inflammation.

L. W. PAUL, M.D.

Obstructive Pulmonary Emphysema Associated with Pneumonia in Childhood. Jerome S. Leopold and Emil A. Kratzman. *Am. J. Dis. Child.* 69: 287-290, May 1945.

Two cases of obstructive pulmonary emphysema associated with pneumonia are presented. The children, aged 6 weeks and 7 months, were both admitted to the hospital with findings typical of pneumonia. Administration of sulfadiazine, 1 1/2 grains per pound

of body weight in twenty-four hours, oxygen, and small transfusions of citrated whole blood resulted in complete recovery. Repeated chest roentgenograms showed the presence and ultimate resolution of obstructive emphysema in the lung fields involved by the pneumonic process.

Radiologically the picture is typical. The emphysematous area consists of an abnormal region of decreased density surrounded by a thin, dense, smooth margin. The area is usually ovoid in shape and occasionally loculated; it may be small or may occupy an entire lobe. Fluid may be present. A characteristic feature is the variation in size of these areas observed in repeated examinations. Diagnosis is based on the typical roentgen findings following an episode of respiratory disease and the absence of abnormal physical and laboratory findings.

LESTER M. J. FREEDMAN, M.D.

Pyopneumothorax in the First Month of Life with Recovery. Two Case Reports. G. P. Rosemond and H. T. Caswell. *Am. J. Surg.* 68: 383-387, June 1945.

Pyopneumothorax, believed to be due to a staphylococcal pulmonary infection, with abscess formation and perforation into the pleural cavity, occurred in 2 infants in the first month of life. Immediate closed drainage was a life-saving procedure in each case.

X-ray examination of one infant on admission revealed complete pyopneumothorax on the right with a shift of mediastinal structures to the left almost obliterating the left lung. Studies the day following drainage showed much less fluid and air in the pleura. Films two days later showed a loculated anterior collection with the mediastinal structures in normal position. Following the drainage of this fluid, x-ray examination revealed for the first time a small radiolucent area which appeared to be within the substance of the right lower lobe. On the infant's discharge, twenty-one days following admission, the radiolucent area persisted. It was believed to represent a pulmonary cyst, a persistent pulmonary abscess, or a loculated empyema. Eleven days later the infant was readmitted with a slight cough, a temperature of 101° F. (rectal), and a white blood count of 17,900, with 73 per cent polymorphonuclears. Roentgenograms having revealed persistence of the "cyst," a few drops of fluid and several cubic centimeters of air were aspirated from it. Immediate relief of fever, cough, and leukocytosis followed. A check-up x-ray almost a year later revealed no abnormality.

In the second case, a roentgenogram showed complete collapse of the right lung, with marked shift of the mediastinum to the left and the presence of fluid and air. A rib resection was done immediately and a mushroom catheter was inserted for closed drainage with constant suction. Films taken every week in the hospital showed steady expansion of the lung and clearing of pneumonia. Check-up studies revealed an entirely normal chest.

Pulmonary Embolism from Obscure Sources. Aubrey O. Hampton, Andrew G. Prandoni, and John T. King. *Bull. Johns Hopkins Hosp.* 76: 245-273, June 1945.

Ten cases are reported in which an acute chest condition is thought to have been caused by pulmonary embolism, with or without infarction, or with incom-

plete infarction, from various venous sources. Eight of the patients were males. All were at work, had no cardiac disease, gave no history of disorder of the veins, and at the time of admission showed no obvious sign of venous thrombosis, with the exception of a thrombosing hemorrhoid in one patient. None had had a recent operation. None was admitted with a correct diagnosis; one was thought to have primary atypical pneumonia, one pericarditis, one cancer of the lungs (metastatic), two coronary occlusion, one angina pectoris.

Roentgenograms of the chest are not very helpful at the onset, since infarcts are ill defined or are not seen at all during the first four to twenty-four hours. Repeated daily examinations are therefore necessary. The lesion is always in contact with a pleural surface, either at the interlobar fissures or at the periphery of the lung. Two or three pleural surfaces are commonly involved by a single infarct; for example, at the junction of fissures or at the costophrenic angles. The long diameter of an infarct is always parallel to the largest pleural surface involved. The medial or cardiac margin of an infarct is convex or "hump"-shaped and sharp in outline when projected on edge. Oblique and lateral films of the chest are often necessary to obtain profile views and thus demonstrate the lesions. Pleural effusion may obscure the lesion for a few days or may not be present at all. Incomplete infarcts may disappear within two or three days, whereas complete infarction persists for two to three weeks and heals by linear scarring. Large infarcts may remain for months with very little change.

Serial electrocardiograms and phlebograms usually elucidate the diagnosis. In 2 of the 10 cases reported here, the electrocardiograms were normal. In one instance, the T waves were sufficiently inverted to suggest myocardial infarction.

In spite of its limitations, the phlebogram yields information which is important in the control of thrombosis and embolism. Early detection of intravascular clotting by phlebography permits prompt institution of appropriate treatment, thereby preventing the occurrence or repetition of pulmonary embolism. The technic employed is that described by Bauer (Arch. Surg. 43: 462, 1941) as modified by Welch, Faxon, and McCahey (Surgery 12: 163, 1942. Abst. in Radiology 40: 322, 1943.) In the authors' experience no serious ill effects have followed the procedure. Vomiting and urticaria have occurred in a few instances. In 164 examinations, no serious hypersensitivity to diodrast has been observed. Phlebography of the lower extremities reveals all the major venous pathways from the ankle to the pelvis and indicates whether or not a vein is patent, whether the lumen is normal or recanalized, whether collateral venous circulation exists and, if so, its extent. Absence of filling of a vein or segment of a vein indicates the presence of thrombosis. Incipient thrombosis in the plantar and calf muscles cannot be detected, since it is only after the thrombus has involved one of the major venous channels that its presence is revealed.

Error in interpretation may arise from an apparent filling defect in the popliteal vein due to hyperextension of the knee during the injection. A convex filling defect frequently seen in the upper third of the thigh is produced by the pressure of the femoral artery on the femoral vein. Venous spasm resulting from apprehension, irritation by the contrast substance, or vein puncture may give rise to narrowing, or, in extreme cases, to obliteration of the deep veins, according to some authors.

Heparin and dicumarol anticoagulant therapy has

been used, with rest and elevation of the part affected by thrombosis or phlebitis. No detectable embolism has been discovered after institution of such treatment.

Numerous roentgenograms are reproduced.

Transient Heart Block in Congenital Heart Disease. Samuel Waldman. *Am. Heart J.* 30: 92-100, July 1945.

In the presence of congenital heart disease, heart block may be present as a functional part of the congenital defect or may occur as an acquired disturbance, superimposed upon the congenital deformity. The heart block may be complete or incomplete, transient or permanent.

The author gives the case history of an 18-year-old male with congenital "heart trouble," who suffered transient episodes of heart block following undue exertion. These episodes were associated with mild attacks of Stokes-Adams syndrome: periodic attacks of giddiness, faintness, and transient periods of unconsciousness lasting a minute or less. An electrocardiogram made three hours after the onset of the attacks showed varying degrees of heart block, with subsequent return to normal. During the filming of Lead II, the patient fainted for several seconds, and periods of lightheadedness with sensations of faintness recurred.

Fluoroscopic and roentgenographic studies showed an enlarged heart, diminished aortic knob, marked prominence of the pulmonary curve, straightened left cardiac contour, and an accentuated left ventricular curve, indicating a patent ductus arteriosus. There was no evidence of a patent interventricular septum.

Parkinson, Papp, and Evans (*Brit. Heart J.* 3: 171, 1941) collected and reported 56 cases of Stokes-Adams attacks with electrocardiograms taken during the attack and added 8 more cases, but none of these is known to have had a congenital basis. Faessler (*Ann. pædiat.* 153: 327, 1939) collected 8 cases of Stokes-Adams attacks in congenital heart disease.

The physiopathology of Stokes-Adams attacks in congenital heart disease is discussed. Fluctuations in the conductivity of the A-V bundle have to do with (1) pressure and tension variations on the bundle, and (2) circulatory variations causing block.

HENRY K. TAYLOR, M.D.

Intracardiac Foreign Body. Report of a Case with Recovery. Robert Shapiro. *Am. Heart J.* 30: 88-91, July 1945.

A 21-year-old male was struck by shrapnel from a Japanese shore battery. At the time of injury he felt only a dull, constricting, non-radiating ache in the right side of his chest, along with some dyspnea. On admission to an army field hospital, eight hours later, he was in shock. Shrapnel wounds were found in the lateral aspect of the right arm, some in the region of the right iliac crest, and one in the right side of the back near the angle of the scapula. A hemopneumothorax was present on the right side with considerable displacement of the mediastinal structures to the left. A small metallic foreign body was observed superimposed on the cardiac silhouette.

The patient responded to therapy and two months later was transferred to a Naval Hospital Facility for further study. Radiographic and fluoroscopic studies revealed a rectangular metallic foreign body, 1.0 X 0.6 cm., embedded in the wall of the right ventricle, in the

region of the conus arteriosus. The 4th rib on the right side posteriorly was fractured. This represented the site of entry of the shrapnel fragment in the heart. No mention is made of removal of the foreign body, but the patient was clinically well at the time of the report, with no cardiac symptoms or signs.

HENRY K. TAYLOR, M.D.

On the Possibility of Studying the Function of the Heart with the Aid of Roentgen-Cinematography. Roentgen-Cinematography Combined with Electric Recordings of the Resistance of the Cardiac Valves. Sven Benner, Sven Roland Kjellberg, and Torgny Sjöstrand. *Acta radiol.* 25: 175-182, June 30, 1944. (In English.)

Experimental studies were done on rabbits to determine the possibilities and limitations of roentgen cinematography in the analysis of the functioning of the heart. The electrical resistance of the atrioventricular valves was measured, and a device for recording differences in resistance due to changes in the position of the valves was used.

With the aid of a contrast medium, a cinematographic study was made of the circulation through the heart, while an electrocardiogram and the electrical resistance between the right auricle and ventricle, the right ventricle and the pulmonary artery, and the left ventricle and the aorta were simultaneously recorded. Thirty-two pictures were made per second.

The authors conclude that while roentgen cinematography with a contrast medium gives an idea of the changes in volume connected with the contractions of the auricle and ventricle, it is not possible by this means to determine the moment of the opening and closing of the valves. Recording of electrical resistance between the various chambers of the heart, on the other hand, yielded results in agreement with those obtained earlier with the aid of other physiological methods.

JOSEPH H. WEISS, M.D.

Intrathoracic Goiters. Frank H. Lahey. *Surg. Clin. North America* 25: 609-618, June 1945.

An old master, speaking of things that are common knowledge to him, limits the designation intrathoracic goiter to those cases in which the thyroid has descended so far into the thoracic cage and has become so widened in its diameter that it is at no time able to escape upward from its deep position in the mediastinum and pass through the upper thoracic aperture.

The origin of intrathoracic goiters is covered, and the author summarizes his remarks by stating that an adenoma usually arises in the isthmus over the lower pole of the thyroid and eventually descends along the course of least resistance, i.e., downward between the fascial planes into the mediastinum. There are two types: the large spherical type and the long tongue of intrathoracic goiter which frequently runs down beside the trachea deep into the mediastinum.

A roentgen diagnosis of intrathoracic goiter is often made when the condition is not suspected clinically, and roentgen examination of the upper mediastinum should not be neglected in cases of adenoma of the thyroid. The tumor most likely to be mistaken for an intrathoracic goiter is a fibroma of the esophagus. The distinguishing feature of the esophageal tumor is the indentation of the esophagus, demonstrable following a thin barium meal. The other lesions to be differentiated are

neurofibromas, dermoid cysts, and pleural cysts. These do not move with swallowing, nor do they cause tracheal pressure and deviation, since they are not anchored to the paratracheal tissues.

The physical findings of the deviated trachea (and larynx), as well as stridor due to compression of the trachea both in the anteroposterior and lateral diameter, are emphasized.

The operative technic is covered briefly and one interesting procedure is mentioned—ligation of the vessels, causing shrinkage of the mass, followed by sucking out the center of the goiter, thus effecting such marked reduction in its size that it can be extracted.

SYDNEY F. THOMAS M.D.

THE DIGESTIVE SYSTEM

Short Esophagus (Thoracic Stomach) and Its Association with Peptic Ulceration and Cancer. D. W. Smithers. *Brit. J. Radiol.* 18: 199-209, July 1945.

This article is primarily a comprehensive review of the literature on short esophagus, or thoracic stomach, from 1836 to the present.

The theories of the cause of thoracic stomach and its association with peptic ulceration are discussed. The few cases found at autopsy compared with the numbers found on clinical examination are strongly against the two common theories suggested to account for the association: (1) that a congenitally short esophagus, by causing relaxation of the cardia and a reflex flow of gastric juice, leads to ulceration; (2) that the esophagus becomes shortened from scar tissue contraction secondary to the formation of peptic ulceration. The author offers an alternative theory. According to this, there is basically a hiatal orifice deficiency, either congenital or, more commonly, acquired in later life. With the cardiac sphincter in the thorax released from diaphragmatic control, gastric juice tends to flow into the esophagus, predisposing to ulceration. This irritation of the esophageal mucosa causes muscular spasm not only circular but also of the longitudinal muscle, producing a shortening of the esophagus. Sometimes there is aberrant gastric mucosa in the esophagus which secretes gastric juice. Ulceration may then take place without evidence of esophageal shortening or hiatal hernia.

This mechanism may be operative in achalasia of the esophagus, also.

Hiatal hernia and associated cancer have been reported several times, short esophagus and cancer rarely. Two new authenticated cases of the latter association are reported, and a third, doubtful, case is added.

SYDNEY J. HAWLEY, M.D.

Singular Case of the Plummer-Vinson Syndrome. Aage Videbæk. *Acta radiol.* 25: 245-250, June 30, 1944. (In English.)

A 60-year-old woman presented the typical Plummer-Vinson syndrome: dysphagia, hypochromic anemia with low serum iron, fissures at the corners of the mouth, spoon nails, and achylia. Roentgen examination showed a constriction in the esophagus, with dilatation above and retention in the piriform recess and the epiglottic valleculae.

The interesting features of the case are the low situation of the stricture, at the height of the clavicle, the esophagoscopic finding of a membranous diaphragm

across the esophagus at the site of the stricture, and the sudden improvement of the patient's condition as soon as the membrane had been cut through. She was subsequently cured of her dysphagia by bougienage, administration of thiamine and riboflavin, and intensive treatment with divalent iron by mouth and intravenously. The roentgenologic picture of the esophagus became normal, there was less anemia, and the state of the nails improved considerably. The effect on the fissures at the corners of the mouth was moderate, and atrophy of the lingual papillae persisted.

JOSEPH H. WEISS, M.D.

Gastric Volvulus and Other Abnormal Rotations of the Stomach. John B. Hamilton. *Am. J. Roentgenol.* 54: 30-40, July 1945.

A rotation of the stomach, reaching or closely approaching 180 degrees, which spontaneously reduces itself, is reducible by manipulation, or can reasonably be assumed to be the result of injury, may be considered to be true gastric volvulus. Other abnormal rotations are those which are not subject to reduction either spontaneously or manually and can be assumed to be variations on a basis of congenital anomalies. Volvulus is classified by the author as (1) organo-axial volvulus (rotation on the coronal axis) and (2) torsion volvulus (about the long axis of the gastro-hepatic omentum).

In the 11 cases described in this paper, relaxed intra-abdominal attachments are believed to have been present. Obesity, trauma, severe weight loss preceding gastric rotation, and anomalous development were varying factors in the etiology. A large, redundant or abnormally situated colon was a feature in several cases of true volvulus. These are often of transient nature. Eventration of the diaphragm on the left side was present in 3 cases. In 2 cases there was herniation of the diaphragm. One patient showed an unusual congenital variation, a right-sided thoracic stomach, congenitally herniated through the foramen of Morgagni. Symptoms varied from pain or discomfort in the epigastrium to nausea and vomiting. There may be remissions between attacks. The characteristic findings in various rotations of the stomach, usually best seen in the upright postero-anterior position, before the fluoroscopic screen, are described and illustrated in connection with the case histories. The condition may be missed unless the patient is examined during an attack.

The organo-axial type of volvulus is the most common. Torsion volvulus must not be confused with the high-lying stomach in the presence of obesity. Cascade stomach has no relation to gastric volvulus. None of the cases reported was of the acute type requiring immediate surgery.

CLARENCE E. WEAVER, M.D.

Hypertrophic Pyloric Stenosis in Infants: Roentgenologic Differential Diagnosis. Russel F. Miller and Herman W. Ostrum. *Am. J. Roentgenol.* 54: 17-29, July 1945.

In examining infants suspected of having hypertrophic pyloric stenosis two erect 8 X 10-inch roentgenograms are taken at 6 feet in the postero-anterior and lateral positions within one-half hour of feeding. These include the chest as well as the abdomen, and thus furnish a survey of the lungs and neck for a possible cause of symptoms. The amount of gas and fluid in

the stomach and the distribution of gas in the small intestine are noted. Abnormal collections of gas limited to one area may indicate some congenital malformation such as bands, non-rotation, or anomalous mesenteric attachments. The infant is then placed in the semi-recumbent prone position for three hours or longer in an attempt to get rid of all the gas in the small intestine and most of the stomach gas. This is important, for a gas-distended small intestine will have an effect similar to an "adynamic ileus" and greatly retard gastric motility; it may even cause vomiting. Antispasmodics are administered throughout the examination in an attempt to eliminate the factor of spasm. Roentgenograms are taken at one-half hour intervals in order to record the periodic emptying of the stomach. In the event of good visualization of the duodenal cap, the gastric motor function is considered to be within normal limits even though the emptying time may be prolonged to four to six hours or more. In pyloric muscle hypertrophy, there is no variability in the length of the prepyloric segment and no cycles of gastric motility. There is a rather regular and constant ejection of barium into the duodenum from the time barium is introduced into the stomach. The duodenal cap is never completely filled.

Gastric hyperperistalsis is common in hypertrophic pyloric stenosis. It was never encountered in either complete or partial obstruction distal to the pyloric ring. In hypertrophic pyloric stenosis, vomiting usually occurs for the first time during the third to fifth week of life with a gradual increase in the severity of the symptoms. Anatomically the pylorus shows a fusiform hyperplasia involving the circular muscle fibers of the pyloric canal and terminating abruptly at the pyloric ring. The constriction ranges in length from 0.5 cm. to 3.0 cm. At the antral end the tumefaction is often seen to project convexly into the lumen of the stomach, forming "shoulders" about the proximal aperture of the canal. When congenital bands obstruct the outlet of the stomach, there is an absence of "shoulders." The pyloric canal may be shown to be normal.

The authors report their observations in 50 infants with symptoms of varying severity. The final complete emptying of the normal infant's stomach is so variable that this feature was found to be of little or no diagnostic importance, for not infrequently traces of barium are found ten to twelve hours or longer after ingestion. On numerous occasions, motility did not really begin until the second or third hour or later; then it proceeded normally. Gaseous distention of the colon or a spastic anal sphincter may cause reflex gastric inactivity and absence of motility for hours.

Early signs of pyloric muscle hypertrophy are an orthotonic or hypertonic stomach with intermittent gastric hyperperistalsis. Later the stomach is hypotonic with feeble, shallow peristaltic waves limited almost entirely to the pyloric region. There is prolonged emptying time, not influenced by antispasmodics.

CLARENCE E. WEAVER, M.D.

Cellular Dynamics in the Intestinal Mucosa: Effect of Irradiation on Epithelial Maturation and Migration. Nathan B. Friedman. *J. Exper. Med.* 81: 555-557, June 1945.

Numerous investigations revealing bizarre degenerative and regenerative phenomena following irradiation

of the gastro-intestinal tract have been reported. The development of numerous mucous cells in the intestinal mucosa has been ascribed to degeneration of the lining epithelium, but little has been known of the mechanism by which the mucous elements appear in such abundance.

The author irradiated male albino rats in groups of 6, giving 1,000 r on one occasion to each of the rats. One or 2 litter mates, which were not treated, were used as controls. During the 96 hours after irradiation the animals were killed at regular intervals by a blow on the head or inhalation of ether. Some were killed after administration of papaverine and magnesium sulfate to counteract smooth muscle spasm. The experiment was repeated five times with similar results for each series of animals. Segments of intestine were taken from the long descending loop of the duodenum and fixed and stained by different methods.

Sections from animals killed within half an hour after completion of irradiation showed nuclear swelling and reduction in the number of mitotic figures. Twelve hours after irradiation no mitoses could be seen, and the nuclei had become swollen and vacuolated sacs; granular masses of chromatin debris from destroyed nuclei were abundant. These changes were confined to the crypts; the cells covering the villi were not affected.

At about 24 hours after irradiation, the crypts, which were normally devoid of fully loaded goblet cells, were seen to contain numerous elements laden with mucous secretion. Between 48 and 72 hours, the epithelial lining cells covering the villi became either abnormally flattened or vacuolated. The clusters of goblet cells disappeared from the crypts and the remaining epithelium became flattened. The aggregations of goblet cells showed progressive migration peripherally as mitosis was resumed. In some animals almost complete recovery appeared in 84 to 96 hours. In such cases the number of argentaffin cells in the intestine was considerably increased.

The author concludes that the accumulation of goblet cells in the crypts after irradiation is due to a transitory arrest in the migration of newly formed elements away from the germinating zone rather than to mucous change in the form of degeneration. The irradiation may have interfered with cellular division without affecting differentiation and maturation.

H. H. WRIGHT, M.D.

Lymphangioma of the Abdomen. An Unusual Case. C. F. Murbach, E. F. Lewison, and G. A. Deibert. *Am. J. Surg.* 68: 391-397, June 1945.

An unusual case of lymphangioma of the abdomen is reported. A 35-year-old Army officer after strenuous physical activity suddenly experienced a sharp stabbing pain in the left hypochondrium. This distress later became dull in character, with no radiation and with no gastro-intestinal symptoms. Laboratory studies and physical examination showed essentially normal findings except for a firm mass palpable in the left upper quadrant. This mass was smooth and its margins were difficult to outline, but it was considered to be about the size of a large grapefruit. A small area of tenderness was present where the mass extended beneath the left costal margin. Dullness was present over the entire abdomen, and ascites was considered likely.

Roentgen examination of the upper gastro-intestinal tract revealed an elevation and partial inversion of the stomach. The greater curvature was deformed by a large, smooth, rectangular filling defect produced by an extrinsic mass. The duodenal sweep presented a J-shaped configuration instead of the normal C-shaped appearance. The distal part of the duodenum and all the jejunal loops were displaced into the right upper quadrant. The appearance of the stomach and loops of small bowel suggested a congenital anomaly—failure of rotation of the small bowel. A barium enema showed the entire descending colon to be pushed toward the mid-line. A crescent-shaped filling defect on the lateral aspect of the descending colon suggested pressure by an extrinsic tumor. Intravenous pyelograms clearly indicated that the left kidney was lower than the right and the left ureter was displaced toward the mid-line in a rather precipitous curve. Examination of the chest revealed an elevated diaphragm, the left dome almost as high as the right. A rather dense, band-like oblique shadow was seen in the left lung field extending to the lateral chest wall. This was thought to be either a thickened interlobar fissure or a focal area of atelectasis resulting from restricted motion of the diaphragm from increased intra-abdominal pressure.

At operation a tumor weighing 18 1/2 lb. and measuring 60 × 25 × 10 cm. was found. Histologically this proved to be a lymphangioma. The patient made an excellent postoperative recovery. Subsequent roentgenograms showed that the viscera had assumed their normal positions and shape; the area of focal atelectasis had disappeared from the left lung field, and the left dome of the diaphragm had descended to its normal level.

The authors call attention to the relationship between the embryonal origin of the lymphatic system and the sites of predilection for lymphangiomas.

Nursing—A Source of Error in Cholecystography. F. Polgár. *Acta radiol.* 25: 174, June 30, 1944. (In German.)

Polgár confirms the observation of Olsson (*Acta radiol.* 24: 489, 1943. *Abst. in Radiology* 45: 634, 1945) that sodium tetra-iodophenolphthalein may be excreted in the milk during lactation, and briefly reports a case. The blue discoloration of the milk lasted about eight hours. In spite of this excretion, the dye visualization of the gallbladder was satisfactory.

ERNST A. SCHMIDT, M.D.

THE MUSCULOSKELETAL SYSTEM

Infantile Cortical Hyperostoses: Preliminary Report on a New Syndrome. John Caffey and William A. Silverman. *Am. J. Roentgenol.* 54: 1-16, July 1945.

The principal features of the new syndrome described by the authors are: onset in the early part of the first year of life; tender swellings in one or more of these sites—face and jaws, scapular regions, and extremities; multiple scattered hyperostoses demonstrable roentgenographically in bones adjacent to the tender swellings and in other bones whose overlying soft tissues appear to be normal both clinically and on the roentgenogram.

In the 4 cases reported by the authors there was no evidence that prenatal deficiency of vitamins or obstetrical trauma was the cause of the infantile

disturbances. In contrast to the multiple massive soft-tissue swellings and extensive scattered hyperostoses, there was a striking paucity of constitutional and systemic manifestations in all stages of the disease. Laboratory findings gave little information of positive diagnostic value. Serological tests for syphilis were all negative. Examinations of the blood revealed no evidence of hemorrhagic disease. Biopsies of affected bones showed only hyperplasia of the lamellar cortical bone; there was no evidence of inflammation or of subperiosteal hemorrhage. The changes in the bones not only do not support the diagnosis of scurvy, but the absence of all the basic scorbutic changes is convincing evidence that the skeletal lesions are not due to deficiency of vitamin C. Pleural exudate was demonstrated in 3 cases with costal thickenings.

The active manifestations subsided completely after several weeks, and there were no serious complications. The cortical thickenings gradually diminished and disappeared after several months. In only one case was there persistent facial swelling, at the age of four and a half years.

In the differential diagnosis scurvy and syphilis must be ruled out. Infection cannot be easily excluded. The possibility of virus infection or allergic reactions as the causal mechanism deserves consideration.

CLARENCE E. WEAVER, M.D.

Effects of Severe Rickets in Early Childhood on Skeletal Development in Adolescence. Ethel C. Dunham and Herbert Thoms. *Am. J. Dis. Child.* 69: 339-345, June 1945.

An interesting follow-up was made during the adolescence of 10 patients treated for severe rickets in early childhood. This group included 6 boys and 4 girls; 1 was a Negro and the 9 white children were of Italian parentage.

Roentgen examination of the pelvis showed rachitic deformity in 5 of the adolescents and no abnormality in the other 5. Three patients having rachitic pelvises were more than four years old when active rickets was diagnosed while 4 patients with normal pelvises were less than three years of age when the disease was discovered. All 10 adolescents had some degree of deformity of the lower extremities. Knock-knees were more often associated with rachitic pelvises than were bow-legs. A high ratio of sitting height to standing height is considered evidence of retardation of growth of the lower extremities. This ratio was found to be high in 8 patients and normal in 1 patient despite the presence of a rachitic pelvis. The remaining patient was not measured.

Of the 10 case histories, 6 are illustrated with photographs of the patient and a roentgen reproduction of the active lesion present in early childhood.

LESTER M. J. FREEDMAN, M.D.

Echinococcosis of Bone. M. Beckett Howorth. *J. Bone & Joint Surg.* 27: 401-411, July 1945.

The author presents a review of the history of echinococcus disease and a discussion of the various reports of echinococcosis of bone. About 1,000 cases of bone involvement have been reported in the literature, including about 10 in North America.

Bone involvement occurs in about 1 per cent of cases of echinococcus disease. The pelvis is involved in

about 36 per cent, the spine in 18 per cent, sacrum in 11 per cent, femur in 17 per cent, tibia in 9 per cent, and the humerus in 10 per cent. Pain, swelling, pathological fracture, and rupture of the cyst are the usual clinical findings.

The laboratory may find scolices, hooklets, or fragments of laminated membrane in the sputum, urine, or feces after rupture of a cyst. Several immunological tests have been developed. Complement-fixation tests and precipitin tests can be done. Aspiration of a cyst may be diagnostic, although there is some danger of anaphylaxis.

Radiologically the cysts are radiopaque. The bone lesions are polycystic, with fairly sharp margins but without productive reaction. Differential diagnosis must be made from giant-cell tumor, cystic tuberculosis of bone, malignant tumor, osteomyelitis, and osteitis fibrosa cystica. The surrounding bone is thinned and may be expanded or ruptured. Necrosis results from arterial occlusion and small sequestra may form. Fracture may occur and non-union may follow.

The treatment is unsatisfactory. Drugs and roentgen therapy are not effective. Excision is the most successful treatment, but amputation may be required.

A lengthy and exact case report of echinococcus bone disease is presented, with numerous roentgenograms.

JOHN B. McANENY, M.D.

Chronic Melioidosis. Case Showing Multiple Lesions of Bones, Joints and Lungs. J. H. Mayer. *J. Bone & Joint Surg.* 27: 479-485, July 1945.

Melioidosis is an infective disease of rodents and man, occurring in the Far East. Several hundred cases have been reported since 1912. In the majority of patients its manifestations are acute, simulating cholera or enteric (typhoid) fever, and death from septicemia has occurred in a few days or weeks. At autopsy abscesses are found in the lungs, spleen, liver, and kidneys. It is assumed that the human infection is acquired through contaminated food or water. Europeans seem to have a greater natural resistance to the infection than natives. The causative organism is the *Bacillus whittmori*, later known as *Pfeifferilla whittmori* or *Malleomyces pseudomallei*.

The case reported is that of a 33-year-old British soldier with lumbosacral pain radiating down the thighs, pyrexia, night sweats, and enlarged inguinal lymph nodes that were negative on biopsy. Roentgenograms of the back were normal. Seven months after the onset of symptoms a lumbosacral abscess developed, and later a right sacroiliac abscess appeared. A year later x-ray examination showed collapse of the body of the eighth thoracic vertebra, with paravertebral abscess but no narrowing of the intervertebral spaces. The base of the right lung became extensively infiltrated. About three years after the patient was first hospitalized, *Pfeifferilla whittmori* was isolated and treatment with an autogenous vaccine was instituted, with subsequent sulfadiazine therapy. One year later he was well on the way to recovery, with all sinus tracts closed and absence of fever for three months.

At one time the diagnosis was tuberculosis but the bacillus was never recovered. There seem to have been many points of similarity between this infection and tuberculosis of the bone.

This case was previously reported by Mayer and Finlayson (*South African M. J.* 18: 109, 1944).

JOHN B. McANENY, M.D.

Osteomyelosclerosis. G. A. Landoff. *Acta radiol.* 25: 81-94, April 1944. (In German.)

Only about 20 cases of osteomyelosclerosis appear in the literature, and in only 2 was the diagnosis made antemortem. The author has reviewed the material found in the literature and has presented a case of his own, in a woman of fifty-seven, in which the diagnosis was made roentgenologically and verified by biopsy. The roentgen picture, pathognomonic of the disease, reveals a general change in the spongy structure of bone, particularly evident in the pelvis and spine. The bony trabeculae are loosely and clumsily arranged as compared to the normal picture. Histologic study shows complete correlation between the roentgen and microscopic pictures. The latter shows a focal type of medullary fibrosis with new metaplastic bone deposition on the spongy trabeculae. Accumulations of eosinophils are present in the medullary fibrous tissue.

VICTOR KREMENS, M.D.

Protrusions of Disks and Nerve Compression in the Lumbar Region. K. Lindblom. *Acta radiol.* 25: 195-212, June 30, 1944. (In English.)

A previous paper by the same author (*Acta radiol.* 22: 711, 1941), in which dorsolateral protrusions of disks at the intervertebral foramina are held responsible for sciatica, is summarized. The present paper represents an extension of the earlier studies, supplementing anatomic findings with clinical observations. The anatomic material consisted of the lumbar portion of the vertebral column obtained from 160 cadavers without reference to clinical symptoms. The clinical observations were based on 732 patients with radiographic examination of abdominal organs, of whom 315 gave a history of lumbago or sciatica. Anatomic studies of disk degeneration and nerve compression were correlated with the clinical records of the cases and the histories of the patients.

As a result of this work, the author feels that symptoms of the sciatica type can be explained on the basis of nerve compression observed in anatomic specimens. These compressions are for the most part outside the vertebral canal, being situated at the outer part of the intervertebral foramina at the point of intersection between the nerve and the disk. In a large majority of the cases, the compression is due to dorsolateral protrusion of a disk. The protrusion in its turn is brought about by degeneration of the disks, characterized by radial fissures, of which those running dorsolaterally play the chief part in producing compression of the nerves.

JOSEPH H. WEISS, M.D.

Osteochondritis Dissecans of the Supratrochlear Septum of the Humerus. W. E. Crysler and H. S. Morton. *Am. J. Roentgenol.* 54: 41-46, July 1945.

It is believed that as the humerus develops, a possible disturbance of local blood supply may occur and account for the loss of continuity resulting in a supratrochlear foramen in one case and the development of the nucleus of an osteochondritis dissecans in another. The vascular disturbance may be incident to minor trauma. The roentgenogram in the classical case discloses a circular button of bone lying in the olecranon or coronoid fossa intimately in contact with the lower and intra-articular portion of the supratrochlear septum. Partial or complete extrusion into the joint space may occur. In some cases, the nucleus may be

fragmented. In others, the supratrochlear septum has an irregular density suggesting multiple incomplete defects or excavations. It was generally found that the opposite elbow revealed either an unusually thin or a perforated supratrochlear septum.

The patients complain of pain and limitation of motion at the elbow. Some of these patients do well with conservative treatment. If there has been an extrusion of the sequestrum, locking may occur. Removal of the osteochondritic ossicle in 5 cases led to complete recovery without known recurrence of symptoms. Histopathologic examination of the removed ossicles disclosed characteristics similar to those of osteochondritis dissecans found elsewhere.

The lesion described has previously been confused with scesamum cubiti. CLARENCE E. WEAVER, M.D.

Osteitis Condensans Ilii. Hugh F. Hare and G. Edmund Haggart. *J. A. M. A.* 128: 723-727, July 7, 1945.

The roentgenologic finding of increased bone density in that portion of the ilium which immediately borders the sacroiliac joint is described and discussed in detail. Twenty-three examples encountered by the authors in one calendar year are reported. In every instance the finding was observed in women between the ages of twenty-three and thirty-eight years presenting the chief complaint of low-back pain with or without radiation. No causative factor has been identified. Features which differentiate this syndrome from Marie-Strümpell disease are enumerated. Symptomatic treatment, augmented by operative fusion of the sacroiliac joints in refractory cases, is suggested.

FRED JENNER HODGES, M.D.
(University of Michigan)

Epiphysitis of the Ischial Tuberosity: Case Report. Paul E. McMaster. *J. Bone & Joint Surg.* 27: 493-495, July 1945.

This is a complete case report of a 19-year-old male with a history of repeated injuries to the region of the left ischium. The original injury was quite severe; the subsequent traumata were less so but sufficient to disable the patient. At the time of this study, the epiphysis of the left ischial tuberosity was ununited and greatly enlarged, possibly four times its normal size. The center for the right ischial tuberosity had united and this bone appeared normal.

JOHN B. MCANENY, M.D.

Pneumarthrograms of the Knee. A Diagnostic Aid in Internal Derangements. W. H. McGaw and E. C. Weckesser. *J. Bone & Joint Surg.* 27: 432-445, July 1945.

The authors have made 508 pneumarthrograms of the knee. Under aseptic precautions and local infiltration anesthesia a 20- or 22-gauge needle is inserted into the lateral infrapatellar space and fluid is withdrawn. The joint is then gently distended with oxygen, usually 80 to 100 c.c., and the needle is withdrawn. Films are made in the anteroposterior and posterolateral projections with spread of the medial and lateral joint spaces. A lateral view in slight flexion is also made. The joint is spread by pressure against its side and counter pressure above and below it. The central ray is directed exactly through the joint space.

The anatomy of the medial meniscus is so simple that any abnormality here is indicative of a lesion. In the lateral joint space the popliteus muscle causes some confusion with the meniscus. The course of this muscle is downward, backward and medially, crossing the posterior aspect of the lateral joint space.

The changes seen are irregularity, blunting or shortening, partial or complete absence, and abnormal size of the meniscus. The synovial cavities and bursae can be defined and the condition of the articular surfaces observed.

Illustrative cases are presented and reproductions of several abnormalities are offered.

JOHN B. McANENY, M.D.

A Third Routine X-Ray Exposure of the Ankle Joint. R. S. Simon. *J. Bone & Joint Surg.* 27: 520, July 1945.

It is suggested that in order better to demonstrate fractures of the lateral malleolus, a view of the ankle be taken with increase of external rotation of the foot, so that the heel is elevated 4 cm. above the film and the tube angulated 30 degrees anteriorly. This position throws the distal tibia anterior to the distal fibula.

JOHN B. McANENY, M.D.

Rotational Deformity in the Treatment of Fractures of Both Bones of the Forearm. E. Mervyn Evans. *J. Bone & Joint Surg.* 27: 373-379, July 1945.

The usual rule of immobilizing fractures of both bones of the forearm in full supination for those of the upper third, and in mid-position for those of the middle and distal thirds, is not always satisfactory. The author has demonstrated that the exact position of fixation of a fracture can be determined by noting the position of the radial tuberosity in a special view of the upper forearm and placing the distal fragment in the corresponding phase of rotation.

The "tuberosity view" is made with the dorsum of the forearm on the film, the elbow flexed at 90 degrees, both condyles of the humerus at the same level from the film, and the tube angled 20 degrees cephalad. In this view the position of the tuberosity of the radius is estimated, and a view of the normal elbow is made in the same degree of rotation to check. At reduction the amount of rotation in which the distal fragment is to be placed is predetermined, and immobilization is maintained exactly in the correct amount of rotation.

The author advises that a chart be made by obtaining, on the same film, successive views of a normal radius in various degrees of rotation, so that the examiner will be familiar with the appearance of the tuberosity in the various phases of rotation.

JOHN B. McANENY, M.D.

Parachute Fractures. Paul A. Knepper. *Surg., Gynec. & Obst.* 81: 53-55, July 1945.

A survey of the fractures which occurred in a regiment of paratroop infantry during a six-month period of intensive training is presented. A total of 129 fractures occurred, of which 79 involved the lower extremities. Fracture of the posterior lip of the tibia is the typical "paratrooper fracture," occurring when the weight of the body is transmitted through one foot instead of being divided.

For treatment of these fractures of the posterior lip of the tibia a padded plaster cast is applied with the foot in the neutral position and the ankle in 90 degrees dorsi-

flexion, and absolute bed rest is enforced for one week. The cast is then replaced by another which has a very small amount of padding. After forty-eight hours, weight bearing is permitted on the cast without crutches. After two weeks the cast is removed and physiotherapy is carried out daily for one week. The patient then returns to full duty. J. L. BOYER, M.D.

Fatigue Fracture. A. Ronald. *Brit. J. Surg.* 33: 90, July 1945.

A brief case report of bilateral fatigue fractures of the fibula.

THE GENITO-URINARY SYSTEM

Administration of Contrast Medium in Urography via the Bone Marrow. Lennart Walldén. *Acta radiol.* 25: 213-218, June 30, 1944. (In English.)

The author experimented with the administration of the contrast medium for urography by way of the bone marrow. Hypertonic solutions are contraindicated and, since most water-soluble iodine compounds used in urography are hypertonic, they must be diluted with sterile water until isotonic. Two hundred cubic centimeters of the diluted medium (10:1) was injected into the sternum. This was absorbed in five minutes, and films of as good quality as those made following injection by the intravenous route were obtained.

This method has proved valuable in cases where the intravenous route for various reasons could not be used. It should be of particular value for urography in children.

JOSEPH H. WEISS, M.D.

Miliary Tuberculosis after Retrograde Pyelography Report of a Case. Åke Lindbom. *Acta radiol.* 25: 219-223, June 30, 1944. (In English.)

During retrograde pyelography, an acute pyelovenous backflow took place in a patient suffering from serious unilateral renal and ureteral tuberculosis. A large quantity of the bacteria-rich content of the renal pelvis came thereby directly into the blood. The patient died from miliary tuberculosis three weeks later. The author concludes that in cases where tubercle bacilli are found in smears of urinary sediment, retrograde pyelography of the suspected kidney should be avoided.

JOSEPH H. WEISS, M.D.

Pathologic and Anomalous Conditions Associated with Duplication of the Renal Pelvis and Ureter. Ruy Goyanna and Laurence F. Greene. *J. Urol.* 54: 1-19, July 1945.

Complete duplication of the renal pelvis associated with complete or incomplete duplication of the ureter is a common anomaly; it was found 25 times in 2,000 consecutive autopsies at the Mayo Clinic. It is in itself of little significance but becomes significant in making the diagnosis of a coexisting pathologic state more difficult.

The most common pathologic condition found associated with duplication in the authors' series was hydronephrosis or hydroureter or both. This was almost twice as common in the lower as in the upper segment. A table of the various associated conditions in a series of 131 patients seen in a ten-year period is given.

The diagnosis of duplication is usually made without much difficulty by means of an excretory urogram. However, if one of the segments is non-functioning,

the excretory urogram may appear normal. In these cases suggestive signs are: (1) an elongated renal shadow, (2) presence of a region of kidney with no means of drainage, (3) characteristic shape of the visualized pelvis. In typical cases, the upper pelvis is usually small, with two major calices. Less frequently only one major calix is present, and least commonly three may be observed. In the lower pelvis the position of the upper calix is typical. The calix extends laterally rather than superiorly, as commonly seen. Probably the most reliable sign of duplication, however, is the elongated renal shadow associated with a large area of kidney with no visible means of drainage.

Cystoscopy and retrograde pyelography are frequently of value in visualizing the pelvis not seen by excretory urography, but even these may fail when the supernumerary orifice is hidden or duplication is incomplete. A history of congenital incontinence associated with normal micturition is strongly suggestive of duplication with ectopic ureter.

Three case reports are given with reproductions of roentgenograms.

ARTHUR W. PRYDE, M.D.

Bilateral Crossed Renal Ectopia: A Case Report. Charles M. Norfleet, Jr. *J. Urol.* 54: 10-11, July 1945.

A case of bilateral crossed renal ectopia, the twenty-fourth to be recorded in the literature, is presented. The diagnosis was made by retrograde urography.

Aneurysm of the Renal Artery. Bernard Levine. *J. Urol.* 54: 17-21, July 1945.

A case of true aneurysm of the right renal artery is

presented in which laminagraphy proved a valuable aid in establishing the diagnosis. Aneurysm of the renal artery is relatively rare, only 76 cases having been reported in the literature. Of these cases only 13 were diagnosed prior to operation or death.

The author's patient was a 59-year-old woman complaining of a constant, boring, non-radiating pain in the right loin of about fifteen years' duration. Two months prior to hospital admission, she had a single episode of hematuria. Physical examination was negative except for slight right costovertebral tenderness. Blood pressure was 170 systolic and 90 diastolic. Laboratory studies showed good function of both kidneys. A gallbladder series revealed a normal gall bladder but a wreath-like calcific shadow was seen on the films medial to the right kidney above the hilar notch. A right retrograde pyelogram made at this time showed a normal configuration of the kidney pelvis and calices. Films taken in different positions showed that the ring-like shadow moved with the kidney. A tentative diagnosis of aneurysm of the renal artery was made. Laminagrams of an excretory urogram showed the calcification to be at the same plane as the right renal pelvis, tending to confirm the diagnosis. Operation was performed through a trans peritoneal approach and revealed a pulsating mass about the size of a walnut which was adherent to the medial aspect of the right kidney and to the lateral aspect of the vena cava. The aneurysm was dissected free and the kidney mobilized and removed with the aneurysm. The patient made an uneventful recovery.

JOHN H. FREED, M.D.

RADIOTHERAPY

Treatment of Bilateral Retinoblastoma (Retinal Glioma) Surgically and by Irradiation. Report on Progress. Hayes Martin and Algernon B. Reese. *Arch. Ophthalm.* 33: 429-438, June 1945.

In 1936 (*Arch. Ophthalm.* 16: 733, 1936), the authors described a new technic for treatment of bilateral retinoblastoma and reported on the progress up to that date in 6 patients, all of whom had then been observed for less than five years. The principles of this method of treatment were: first, the surgical removal of the eye with the more advanced involvement; second, fractionated roentgen irradiation of the remaining eye in an attempt to conserve vision. In 1942 (*Arch. Ophthalm.* 27: 40, 1942), a second report was published, adding 4 new cases, and describing certain modifications in the technic. In the present communication the authors present the follow-up data in the cases previously reported and record the results to date of treatment in 14 additional cases, making a total of 24 cases of bilateral retinoblastoma treated by this method.

Nine patients were treated five or more years ago. In one case, the result was indeterminate. Two of the remaining 8 patients died from the retinoblastoma, 2 are living without recurrence and with vision, and 4 are living without recurrence but are blind. Of the 14 patients treated during the last five years, 3 have died of the disease or have a hopeless recurrence; 3 are regarded as partial failures, for although the growth appears to be under control, the patients are blind; 8 have freedom from disease with vision.

The intraocular changes and the complications fol-

lowing fractionated roentgen radiation therapy in case of retinoblastoma are described in the two preceding reports; supplementary information on the effects of radiation on retinoblastoma and on the eye in general is given here.

Data on the apparatus, the irradiation factors, and the technic of application are briefly summarized in the present report; for a more detailed description the reader is referred to the earlier papers.

Response to Preoperative Irradiation as a Clue to the Management of Breast Cancer. Leo M. Levi. *Am. J. Surg.* 68: 355-357, June 1945.

A series of 121 cases of breast cancer was studied to determine if the response to preoperative irradiation gave any clue as to the best management of the disease. The customary daily dose was 300 r (in air) given through a 10 × 10-cm. supraclavicular port and to each of two opposing breast portals (usually 10 × 15 cm.) for a total of 1,800 r each. The axillary field (10 × 10 cm.) received 1,500 r. The factors were 200 kv., 50 cm. T.S.D., 0.5 mm. Cu plus 2.0 mm. Al filtration, 1.0 Cu h.v.l., intensity 35 r per minute. The skin effect was seldom marked. A brisk dry skin reaction was observed. Surgery was performed.

The tumors of 53; sion, i.e., there was mass that it was "enlarging" or "necrotic" group, 29 subsequent

periods ranging from six months to six years. Eleven of the 29 who received irradiation, with a subsequent radical mastectomy, and 14 of the 24 patients treated by irradiation alone, survived. The average interval from treatment to the appearance of metastasis in the irradiated patients with surgery was 10.77 months, in those treated by irradiation alone, 16.22 months.

The plan of classification and treatment for breast cancer followed at the Los Angeles County Hospital is presented.

Present Status of Diagnosis and Treatment of Uterine Carcinoma. Hugh F. Hare. *Surg. Clin. North America* 25: 536-541, June 1945.

This brief article from the Lahey Clinic reviews the dependable ways of diagnosing and treating cancer of the uterus. While the vaginal smear technic is used, the author states that sole dependence is not to be placed on this method; it is, furthermore, reliable only in the hands of a highly trained man. Routine biopsy with stout adaptable biopsy forceps is done in all cases of cervical ulceration.

The method of treatment at the Lahey Clinic in early (Grade I) lesions is surgical excision. In more advanced lesions the author recommends external irradiation given to 4 portals (2 anterior and 2 posterior) at the rate of 100 r a day to a total of 2,000 r to each portal. He then goes on with the misleading figure, "8,000 r" total in air; in other words, a summation of the dosage to the four fields. Following external irradiation, radium is applied within the uterus, 3,000 mg. hr. in each of two sittings, 50 mg. being placed in the uterine end of the tube and 150 mg. in the cervical end. Two or three weeks later, interstitial radium is used with a similar dosage "into and around the lesion."

While no figures are given, considerable success is claimed, exceptions being those cases in which the disease has invaded contiguous structures, namely the bladder and rectum.

Surgical removal of carcinoma of the body or fundus is followed by external irradiation given as outlined above.

The author points out that vigorous irradiation of the patient with hopelessly advanced disease is not warranted; he feels that treatment in such cases should be given for palliation only.

One interesting side light which is brought out is the seeming confusion to be found in the literature on the treatment of carcinoma of the uterus with irradiation. It is pointed out that shock-proof apparatus of 200, 400, and 1,000 kv. were developed almost simultaneously, and at approximately the same time more accurate measuring of dosage and applications of depth dose (as well as isodose charts) were put in use.

SYDNEY F. THOMAS, M.D.

Paget's Disease on the Nipple with Special Reference to Its Course and Treatment. Karen Lübschitz. *Acta radiol.* 25: 127-148, April 1944. (In English.)

This study, emanating from the Radium Centre in Copenhagen, presents a review of the history of Paget's disease, the various conceptions of its pathogenesis, and an analysis of 27 cases of Paget's disease of the breast with respect to diagnosis and therapy.

A cross section of the pertinent literature since 1876 fails to resolve the question as to whether the super-

ficial eruption on the nipple and the areola is a cancer or a precancerous affection, and what the inherent connection is between this superficial lesion and the cancer which develops in the breast.

Relatively few cases of Paget's disease have been reported as treated by roentgen irradiation. The author has utilized and attempts to evaluate this treatment in 25 cases. In all cases but one the diagnosis was verified by histologic examination. In 15 cases roentgen therapy was the only treatment employed, and in a group of 10 cases surgery was performed at a later date, owing, as a rule, to recurrence. The technic and dosage were not uniform, but the majority of cases received a total dose of 4,000 to 6,000 r. The irradiation varied from low-voltage (60 kv., 2 to 4 ma., 0.1 mm. Cu filtration, distance 5 to 7 cm.) to slightly deeper treatment (100-180 kv., 2 to 4 ma., 1 to 3 mm. Al, distance 15 to 40 cm.).

The author at the time of publication states that this technic and dosage are now considered inadequate, despite the fact that in 5 cases out of 14 dating back more than five years not only was the Paget's lesion on the breast completely healed, but for a considerable number of years no tumor formation has appeared in the deeper part of the mammary gland. It is now felt that in those cases of Paget's disease where advanced age or complications of other kind increase the risk of, or contraindicate, operation, there will be, as in technically inoperable cases, reason to attempt curative roentgen treatment. This must be accomplished by fractional, protracted irradiation of the entire breast and axilla with a total dose of at least 4,000 r in about four weeks.

The conclusion reached is that there is a prospect, with improved technic, of a curative effect without surgery, but it is stressed that as yet no such convincing results have been obtained as would justify the use of roentgen therapy alone. For the present the normal procedure in every case of Paget's disease must, as far as possible, be to use radical surgery after the same principles as in operable mammary carcinoma, utilizing the benefits of strong, fractional, preoperative irradiation.

It will no doubt take some time before it will be possible, on the basis of clinical observation, to come to a safe estimate of what may be accomplished by roentgen treatment alone in this disease, especially since the condition is a relatively uncommon one.

VICTOR KREMENS, M.D.

Irradiation Failures in Early Cervical Cancer. Improved Irradiation or Return to Surgery? Franz Busehke and Simeon T. Cantril. *Am. J. Roentgenol.* 54: 60-69, July 1945.

It is now generally accepted that statistically the results of adequate radiation therapy are superior to those of the radical Wertheim hysterectomy in the treatment of epidermoid carcinoma of the cervix in all stages. Adequate radiation therapy yields results at least equal to excellent surgery, if the problem is viewed from a statistical point of view. In those instances in which surgeons have become disappointed with irradiation results, a critical analysis shows that those results were not up to par, i.e., the cure rates are lower than those which have been attained by the leading radiological institutions, which must be considered as the standards for comparison. The fact remains that now, as fifteen years ago, 20 per cent of Stage I and at least

30 per cent of Stage II cases are not cured by even the most competent and skillful radiation therapists. The reason for this may be found in a careful analysis of the individual unsuccessfully treated cases.

An analysis is made of failures in cases treated by the authors between 1935 and 1938. Nineteen patients out of a total of 79 with cancer of Stage I or II are dead or show active disease. Three patients with controlled carcinoma died of complications secondary to an intestinal irradiation necrosis, one of them combined with a necrosis of the bladder. These patients were treated when the dangers of supervoltage roentgen therapy were not sufficiently understood or appreciated. In the early stages severe intestinal reactions are today considered as due to faulty treatment. One patient who died of sepsis was given intracervical radium therapy before a pelvic cellulitis was properly controlled. Two patients might have been saved by a better spatial distribution of the dose. Four patients are listed as unexplained failures. They all died of parametrial recurrence. The treatment in these 4 cases was considered adequate according to today's standards. None of the failures in this series was due to uncontrolled or recurring cancer in the cervix itself. A radium dose below 8,000 mg. hr. (with adequate distribution in space and time) cannot be considered adequate even if one occasionally seems to obtain results with less.

It seems from clinical observation and from analogies that radiation therapy can control pelvic disease beyond the cervix if it represents a diffuse direct invasion through the lymphatics of the broad ligament, but not disease of the lymph nodes. Admitting that there is a small group of cases for which a permanent cure with our present methods of radiation therapy is unlikely, the question arises as to their actual chances if surgery is used. Taussig (Am. J. Obst. & Gynec. 45: 733, 1943) recommends for Stage II cases a combination of radiation therapy to the cervix and its immediate neighborhood and iliac lymphadenectomy. One objection to this is that no attempt is made to remove the lymph nodes around the lower portion of the ureters because this would make the operation more complicated and risky, and a second objection is that, after intensive radiation therapy by a combination of a maximum radium and a maximum roentgen dose, a procedure such as iliac lymphadenectomy carries considerable risk. The statistical evaluation of Taussig's results, in which he computes a 68 per cent greater salvage than by irradiation alone, seems erroneous. By analyzing the irradiation procedure used for comparison with his, the authors found that the irradiation applied in that series has been greatly improved through the years. Yet the earlier cases were apparently included in the material for comparison.

It seems quite logical that, if surgery is done, it should be in the form of the radical Wertheim operation without considering radiation therapy. Meigs (Surg., Gynec. & Obst. 78: 195-199, 1944) has recently revived this classical procedure. Of the 65 patients operated upon by him, 53 had no cancerous lymph node involvement. Two of these are dead. In 12 cases the lymph nodes were involved. Three of this group are dead. Thus, out of a group of 65 patients, 9 were saved who would not have been saved by irradiation, granting that radiation cannot sterilize lymph node metastases. This means that 20 patients have to be subjected to this radical operation in order to save 3

that could not have been saved otherwise. Meigs' requirements are very strict. Ideally, the patient should be thin, young, in good health, and have an early cancer. Three of the authors' cases which were failures would not have been accepted for surgery according to Meigs' rigid standards.

It is felt that improvement of radiation therapy by more careful attention to details of technic, by the elimination of inadequate procedures of the past, and by the careful adaptation of the procedure to the individual requirements will probably save more patients than a return to surgery.

CLARENCE E. WEAVER, M.D.

Hodgkin's Disease. Salient Clinical Features and Relative Value of Various Methods of Treatment Based upon Study of 319 Cases. Leonard B. Goldman and Abraham W. Victor. New York State J. M. 45: 1313-1318, June 15, 1945.

The authors discuss the salient clinical features and the relative value of various methods of treatment of Hodgkin's disease based on a study of 319 histologically proved cases. Of this series, 193 were observed until death and 69 had complete postmortem studies.

The chief complaint of the majority of patients when seeking medical aid is a "swelling," usually in the neck. Deft palpation of the involved lymph nodes may permit a clinical diagnosis of Hodgkin's disease. The nodes are irregular, resilient, and differ in consistency, depending on the histologic picture. Matting may or may not be present. Elastic, relatively soft nodes indicate marked parenchymal proliferation and such nodes regress more rapidly under radiotherapy than firmer nodes attached to surrounding structures. In 13 of the patients there was involvement of lymph nodes at the edge of the sternum along the course of the internal mammary artery. The authors consider these prominences to be pathognomonic of Hodgkin's disease.

Pleuritis was an outstanding symptom. One hundred and twenty-four patients showed diverse cutaneous manifestations, but only a few of these presented a microscopic picture characteristic of the disease. The most common finding was small, scratched papules. Herpes zoster was present in 24 cases. Subcutaneous nodules were found in only 2 cases. This is in contrast to lymphosarcoma, in which the subcutaneous tissues and mucous membranes are frequently involved while the skin is spared.

The mediastinum is frequently involved but seldom without coexistent adenopathy in the cervical, supraclavicular, or axillary regions. The parenchyma of the lung showed involvement in 25 of the patients, with lesions varying in size from 2 to 7 mm. Bloody pleural fluid, obtained by paracentesis, was rare.

The gastro-intestinal tract was involved in only 2 cases, the stomach in one and the sigmoid in the other, in contrast to its frequent involvement in lymphosarcoma. Fourteen patients showed obstructive jaundice, usually indicative of compression of the biliary duct system. The jaundice disappeared following irradiation. Splenomegaly was not an early finding and was not marked in degree in later cases. In 27 of the patients the disease was confined almost entirely to the abdominal cavity.

Bone involvement was present in 20 patients. No characteristic roentgenographic picture was seen, the lesions in most being osteolytic and osteoblastic.

tinguishable from metastatic carcinoma. The vertebral column was the most frequent site of involvement.

The white blood count was normal in most cases. Where leukopenia was present, it was not considered a contraindication to irradiation, provided heavy roentgen therapy had not already been administered. A mild secondary anemia was usual. Stereal aspirations in 91 cases showed one or more of the following characteristic findings; a polymorphonuclear shift to the right with marked toxic granulation; increase of eosinophilia of young myeloid elements; increase in the monocytic series.

Pregnancy occurred in 11 patients and in none was there evidence that the course of the disease was altered or that there was any effect on the offspring.

With proper treatment, useful life of the patient may be prolonged for many years, although permanent arrest of the disease is not to be expected. The authors advocate the smallest quantity of radiation that is compatible with the patient's relative well being, just sufficient to cause gross disappearance of involved lymph nodes. The first area treated is the site of the patient's chief symptom or the most prominent site of involvement. A voltage of 200 kv. with a filtration of 0.5 mm. Cu and 1 mm. Al was used in most instances. Higher and lower voltages appeared to give inferior results. Constant supportive hematologic therapy is advocated.

H. H. WRIGHT, M.D.

Therapeutic Use of Radioactive Phosphorus. Shields Warren. *Am. J. M. Sc.* 209: 701-711, June 1945.

Radioactive phosphorus produced in a cyclotron by the bombardment of red phosphorus placed in the external target chamber gives a product of relatively low specific activity. Bombardment of an iron phosphide probe placed in the deuteron stream gives a product of high specific activity.

The chemical manipulation which converts the phosphorus to dibasic sodium phosphate has no effect on the radioactivity. The half life of radioactive phosphorus, 14.3 days, is long enough to permit the chemical manipulations necessary to prepare it for administration without undue loss of activity. The half life is short enough to have no long-range harmful effects on the body. The beta rays given off have relatively low penetrating power (2-4 mm. of tissue), and the end product of the reaction, sulfur, is not radioactive and is harmless. It has been calculated that 0.1 microcurie of radioactive phosphorus has the same ionizing effect as 4.2 r of therapeutic roentgen rays delivered per gram of tissue in twenty-four hours.

Radioactive phosphorus was administered as disodium acid phosphate, or as magnesium ammonium phosphate, or even as phosphoric acid. The desired dose was usually given intravenously in 300 c.c. of normal saline and 5 per cent glucose solution in adults, or in a volume of 100 c.c. in children. When given orally, the material was dissolved in 150 c.c. of orange juice. With this method, from 20 to 30 per cent of the dose was not absorbed because of precipitation in the gastro-intestinal tract of a portion as insoluble phosphates.

The highly radiosensitive diseases such as leukemia and the lymphomas were treated. It was decided to limit the treatment to cases which had become resistant to roentgen rays, and to the acute leukemias of childhood, which are known to do badly with roentgen irradiation.

Thirty-one cases had been treated with roentgen

rays and had either failed to respond or proved to be resistant from the start. Fifty cases had had no previous radiation therapy. The cases which were helped showed definite clinical and laboratory evidence of improvement for a period of three months or more. The best results were obtained in previously untreated cases of chronic and subacute myelogenous leukemia and in cases of lymphatic leukemia previously treated with roentgen rays. The cases of leukemia in children did badly.

The degree of leukemic infiltration of the bone marrow is important, since, if the involvement is extensive and normal hematopoiesis is slight, the change will be only from a leukemia to an aplastic anemia. Therapeutic doses of radioactive phosphorus do not appreciably damage red cell formation. Radiation sickness was encountered only once.

Owing to the ready diffusibility of the phosphate ion, radioactive phosphorus permeates all of the body tissues and fluids, but the leukemic tissue picks up a considerably higher concentration than does normal tissue. Certain tissues, as liver, kidney, spleen, and bone marrow, show proportionately large amounts of the radioactive substance. Soon after administration, the concentration in the saliva is as much as that in the blood. The normal spinal fluid does not attain any appreciable amount until a number of days has passed. Several days after injection, the bile may contain large amounts, owing to the selective action of the liver.

Intravenously administered radioactive phosphorus is practically all excreted by the kidneys. Appreciable amounts of the substance in the feces indicate intestinal hemorrhage or extensive mucosal leukemic infiltration.

BENJAMIN COPLEMAN, M.D.

Radioactive Phosphorus in the Treatment of Polycythemia Vera. Results and Hematologic Complications. Byron E. Hall, Charles H. Watkins, Malcolm M. Hargraves, and Herbert Z. Giffin. *Am. J. M. Sc.* 209: 712-717, June 1945.

Radioactive phosphorus was employed intravenously for the treatment of 12 cases of polycythemia vera. The initial dose varied from 4 to 7 mc., and second and third injections were given whenever the material was available. Satisfactory remissions were induced in 8 of the 12 cases. Incomplete remissions occurred in 2 cases and were probably due to inadequate treatment. When satisfactory remissions occurred, both clinical and hematologic improvement were noted. The remissions have lasted from eight to twenty-six months.

There was noted considerable variation in the doses required to induce satisfactory remissions. While Lawrence and his associates (*Radiology* 39: 573, 1942) recommended 2 injections of 7 mc. each, three weeks apart, it was found that many, presumably milder, cases responded satisfactorily to a single injection containing as little as 4 mc.

There were no toxic reactions or evidences of radiation sickness. However, such complications as anemia, leukopenia, and thrombocytopenia were observed in several cases. Acute leukemia developed in one patient who had symptoms attributable to polycythemia vera for three and one-half years prior to the administration of radioactive phosphorus. Death occurred eighteen months after a single injection of 7 mc. While on a theoretical basis there may be a

causal relationship between the administration of radioactive phosphorus and the occurrence of acute leukemia, the material had lost its radioactivity long before the leukemia developed, and in other patients receiving treatment over longer periods of time this disease did not occur.

The effectiveness of radioactive phosphorus in treatment is well established. Patients may not only obtain complete relief, but they require no other forms of therapy. The dose must be individualized for each patient.

The action of radioactive phosphorus is similar to that of roentgen therapy to the bone marrow, in that erythropoiesis is decreased. Although hematologic complications may occur, serious bone marrow damage can be averted by frequent hematologic studies.

BENJAMIN COPELMAN, M.D.

Roentgen Therapy of Arthritides. Ira I. Kaplan. *New York State J. M.* 45: 1339-1343, June 15, 1945.

The widespread incidence of arthritis and the failure of the usual methods of treatment to provide cure or lasting relief in any large proportion of cases emphasize the importance of giving serious consideration to radiation therapy.

Many reports, particularly in the recent literature, indicate roentgen therapy to be of definite benefit in the arthritides. It is most effective in infectious arthritis, rheumatoid arthritis, and Marie-Strümpell disease. Most workers emphasize the value of radiation therapy in reducing pain and increasing function of the involved joints. Some claim cure from irradiation in early stages of arthritis. Others have noted no anatomic change demonstrable roentgenographically following treatment. The response is most satisfactory in cases treated early.

Bursitis and peritendinitis calcarea in the acute and subacute stages show excellent response to roentgen therapy, which in the opinion of many workers is the treatment of choice for these conditions.

H. H. WRIGHT, M.D.

TECHNIC AND DOSAGE

Evaluation of Different Factors in Rotation Therapy. Sv. Hoeffler Jensen, Jens Nielsen, and V. Thayssen. *Acta radiol.* 25: 95-104, April 1944. (In English.)

Rotary roentgen irradiation has of late been the object of considerable interest and had been dealt with in a number of papers. Up to the present some 150 cases of esophageal cancer have been treated by rotation therapy by the authors.

The distribution of the dose in the irradiated body can be determined either indirectly by calculation or directly by measurement on suitable phantoms. The authors conclude that the indirect method is frequently uncertain and too time-consuming. Direct measurement on suitable phantoms is the method to be preferred.

Rotary irradiation may be characterized by a statement of the relation of skin dose to axis dose. This relation is dependent on the focus-axis distance, the half-value layer of the radiation, the object size, the field used, and the shape and density of the object. When the focus-axis distance and the h.v.l. are as great as possible, and the field size and phantom density are as small as possible, the best ratio of skin dose to axis dose is obtained. Absolute and relative

values of tumor dose with respect to varying chest circumferences have been determined by direct measurements in the esophagus in patients receiving rotary irradiation.

One hundred and eighty kilovolts, 15 ma., 0.5 mm. Cu, and a focus-axis distance of 50 cm. represent appropriate factors for rotary irradiation of esophageal cancer.

VICTOR KREMENS, M.D.

Dose Distribution in Rotary Irradiation of Eccentrically Situated Axial Field as Basis for Experiments with Rotation Treatment of Cancer of the Rectum. Paula Wissenberg. *Acta radiol.* 25: 105-112, April 1944. (In English.)

"The object of this study has been to determine, experimentally and clinically, whether it is possible by rotary irradiation of an eccentrically situated tumor, when the tube rotates 180 or 360 degrees about an axis in the tumor, to obtain such a distribution of the dose that there is reason to expect a more favorable effect than by irradiation through stationary fields."

Esophageal cancers, as compared to eccentrically situated rectal lesions, may be considered as being centrally situated. A nearly homogeneous irradiation in the axial field and a rather sharp drop of the dose outside the latter can be obtained in centrally situated lesions, with a ratio of about 1 to 3 existing between surface dose and maximum (tumor) dose. A different and less advantageous intensity curve is obtained in the case of eccentrically placed tumors.

A cylindric paraffin phantom was used for estimation of the tumor dose which could be obtained by rotary irradiation of cancer of the rectum. Measurements were made with a spherical ionization chamber (condimeter chamber) about 1 cm. in diameter placed in holes bored in the phantom. Measurements were made with reference to (1) 180 or 360 degrees rotation; (2) size of the field; (3) position of the axis; (4) focus-axis distance.

Results indicate that "rotary irradiation of an eccentrically situated axial field does not give as good distribution of the dose as centric radiation over an arc of 360 degrees. Homogeneous irradiation of the tumor region cannot be obtained." It is questioned whether a markedly greater tumor dose can be delivered than by irradiation through fixed fields. It is true, however, that intersecting of the beams of the fixed fields is avoided.

The clinical results of rotation treatment of 19 cases of inoperable cancer of the rectum are reviewed. The effect on the tumor does not seem greater than that obtained by irradiation through multiple fixed fields. There is, however, the advantage of shorter treatment time and less discomfort to the patient.

VICTOR KREMENS, M.D.

A Slide Rule for Determination of Dosage from Linear Radium Applicators. G. Rudinger. *Am. J. Roentgenol.* 54: 72-77, July 1945.

The author summarizes his paper as follows: "A multiple slide rule is described which permits quick calculation of the dose delivered by radium or radon needles as used in gamma-ray therapy. It can also be used for rapid determination of relations between quantities affecting the dose. The theory of the design is outlined and some details are given regarding the mechanical construction of a simple model. The accuracy obtainable is sufficient for clinical use."

CLARENCE E. WEAVER, M.D.

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Radiographic Diagnosis of Prolapsed Redundant Gastric Mucosa into the Duodenum, with Remarks on the Clinical Significance and Treatment¹

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PROLAPSES OF redundant or hypertrophied gastric mucosa into the duodenum occur frequently enough that they should be recognized and their clinical significance properly evaluated. Experience in the past few years indicates that the filling defects thus produced occasionally are misinterpreted and confused with those due to duodenal ulcers, duodenitis, or similar disorders. Furthermore, when such prolapses are present, the tendency of some physicians has been to regard the condition as of no clinical significance.

In the U. S. Navy, the diagnosis of duodenal ulcer is a serious matter, as it involves decisions regarding promotion, type of duty, or even separation from the service. On the other hand, a man incapacitated by gastric distress from a prolapse of the gastric mucosa, with or without the complications of hemorrhage or obstruction, can be rehabilitated by surgical measures and returned to active duty.

INCIDENCE

In eleven months there were admitted to a large Naval Hospital over 19,000 pa-

TABLE I: INCIDENCE OF GASTRIC AND DUODENAL LESIONS, (OCTOBER 1943 TO SEPTEMBER 1944)

Hospital admissions.....	19,228	
Upper gastro-intestinal series.....	1,346	
Gastric ulcers.....	13	(0.96%)
Duodenal ulcers.....	325	(24.1%)
Duodenitis.....	17	(1.3%)
Prolapse of gastric mucosa.....	14	(1.04%)
Gastric tumors.....	0	

tients. On them were made 1,346 successive roentgen examinations of the upper gastro-intestinal tract (Table I): 13 patients were found to have gastric ulcers, 325 patients duodenal ulcers, 17 patients duodenitis, and 14 patients prolapses of the gastric mucosa. No cases of gastric cancer were discovered. Thus, in this group of young and adult men, prolapse of the gastric mucosa occurred as often as gastric ulcer. It should be pointed out that the roentgen diagnosis of duodenal ulcer was not neglected, since it formed 24 per cent of the diagnoses. This high figure should not be construed as representing the incidence among naval personnel, as all patients in whom a peptic ulcer is found or suspected at the medical dispensaries in a large district are sent to this hospital for evaluation and disposition.

¹ The opinions or assertions contained herein are the private ones of the writers and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large.

Read at the Joint Meeting of the American Roentgen Ray Society and the Radiological Society of North America, Chicago, Ill., Sept. 24-29, 1944.

² Released from active duty and now Associate Professor of Clinical Radiology, Washington University School of Medicine, and Assistant Director of the Mallinckrodt Institute of Radiology, Saint Louis.

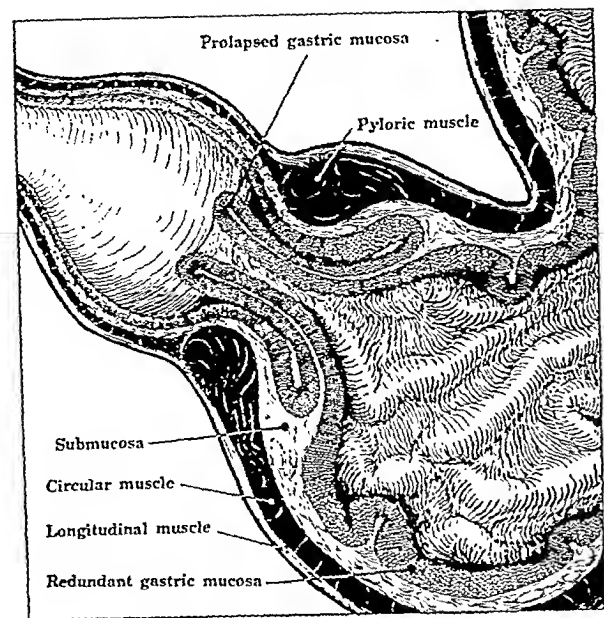


Fig. 1. Diagram of antrum of stomach and duodenum illustrating a large prolapse of the gastric mucosa.

The great proportion of the muscle fibers in the walls of the stomach end in the pyloric muscle. With this construction they are firmly anchored and do not prolapse. This permits large hypertrophied and redundant loose folds of gastric mucosa to invaginate through the pylorus into the duodenum. From the duodenal side the prolapsed gastric mucosa appears as a loose protruding "collar." Only the mucosa and submucosa arc in the prolapsed folds of tissue.

This diagram also explains the production of the characteristic "cauliflower" negative filling defect in the base of the duodenal bulb. The barium fills the bulb completely except for the space occupied by the prolapsed gastric mucosa, which gives the negative shadow. The filling defects necessarily vary in shape, size, and extent during any one examination, as the folds of prolapsed mucosa are soft and flexible, and at times are partially or completely reduced and remain within the stomach. Drawing by Louise Garden.

The 1.04 per cent incidence of gastric prolapse is higher than that given by Rees (19), whose group found this disorder 4 times in 3,000 x-ray examinations, or at another hospital, where it was observed twice in 2,550 x-ray examinations. Melamed and Hiller (14) found only 19 proved cases in the literature, which with their one case made a total of 20 in 1943. Archer (1) states that prolapsing gastric mucosa is not rare, but gives no figures. In my experience, prolapses of the gastric mucosa occur more frequently than is generally recognized. They are overlooked because: first, the examiner is not thinking about them; second, the filling defect pro-

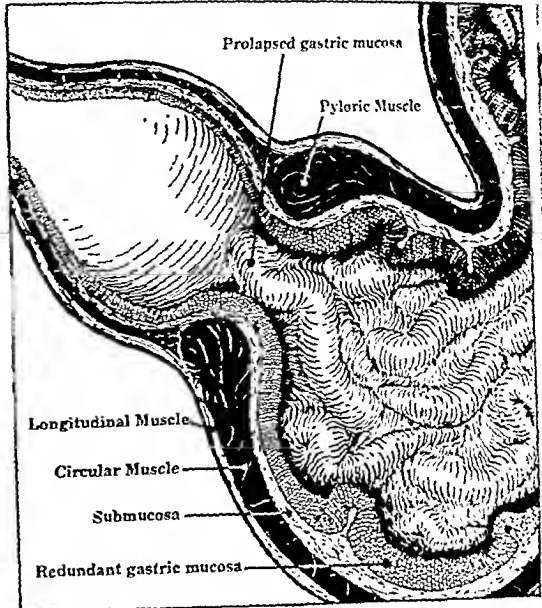


Fig. 2. Small prolapse of the gastric mucosa. Small prolapses are more common and are usually of less clinical significance.

In the early stages of development a small fold of gastric mucosa may protrude into the base of the duodenal bulb to give a small negative shadow. These defects are easily recognized and differentiated from duodenal ulcers, as they occur opposite the pyloric opening. Compare with Figs. 15, 16, and 17. Drawing by Louise Garden.

duced by the prolapse is confused with that due to a duodenal ulcer or a duodenitis; third, when recognized, they are sometimes passed over and not mentioned.

It is our contention that the roentgenologist should make a positive effort to find this disorder, to distinguish it from duodenal ulcer or other duodenal filling defects, and to report its occurrence to the referring physician. At the same time, it should be made clear that not every patient with a prolapse of the gastric mucosa has a serious disorder or that surgical measures are invariably indicated.

The age incidence is not striking. The largest number of cases occurred in the fourth decade.

20-29 years.....	1
30-39 years.....	2
40-49 years.....	3

ETIOLOGY

The underlying factors, leading to mucosa is not

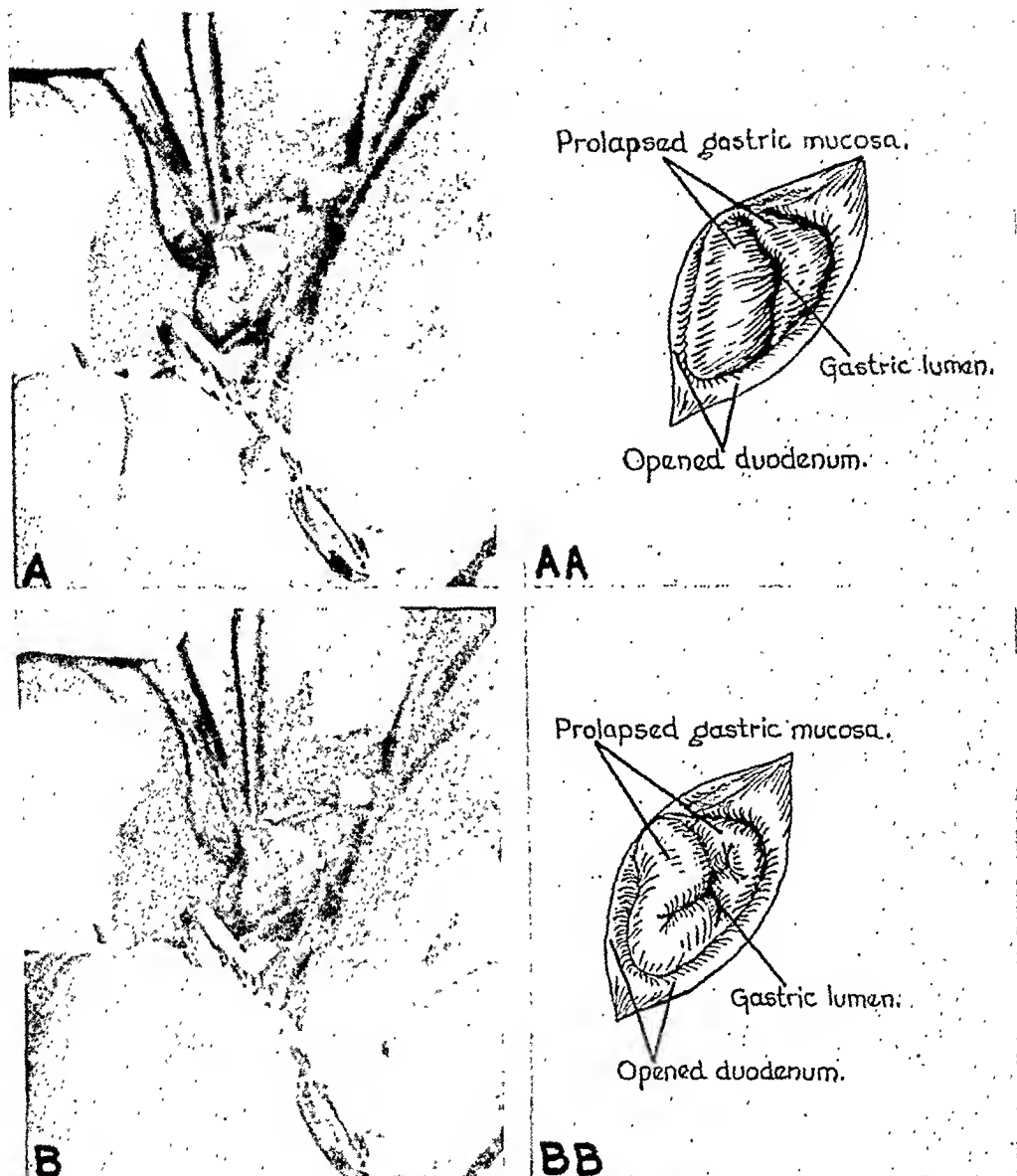


Fig. 3. Photographs made at operation after the duodenal bulb had been incised and opened demonstrate the prolapsed "collar" of gastric mucosa projecting well into the duodenum. Case IV.

A. The prolapse "collar" is spread out and shows the canal leading back into the stomach.

B. The redundant "collar" of prolapsed gastric mucosa could be manually reduced but would slowly protrude again in loose folds, obliterating the canal leading into the stomach.

AA and BB are tracings of the adjacent photographs.

have been offered. Eliason and Wright (8) believe that a low-grade inflammation of the mucosa produces a local hypertrophy. The hypertrophied folds are enlarged mechanically by the contractions of the stomach and the pressure of gastric contents. As a result, they are lengthened and "pushed along" toward the pylorus. When sufficiently long, they are swept into the duodenum by a peristaltic wave.

Rees (19) proposes another mechanism, in which a narrowing of the pyloric lumen precedes the actual change in the gastric mucosa. The narrowing is followed by hyperperistalsis of the stomach in an effort to force its contents through the smaller opening. This action loosens the attachment of the mucous membrane to the muscularis. When the mucosa is so mobilized, it is subjected to trauma, which

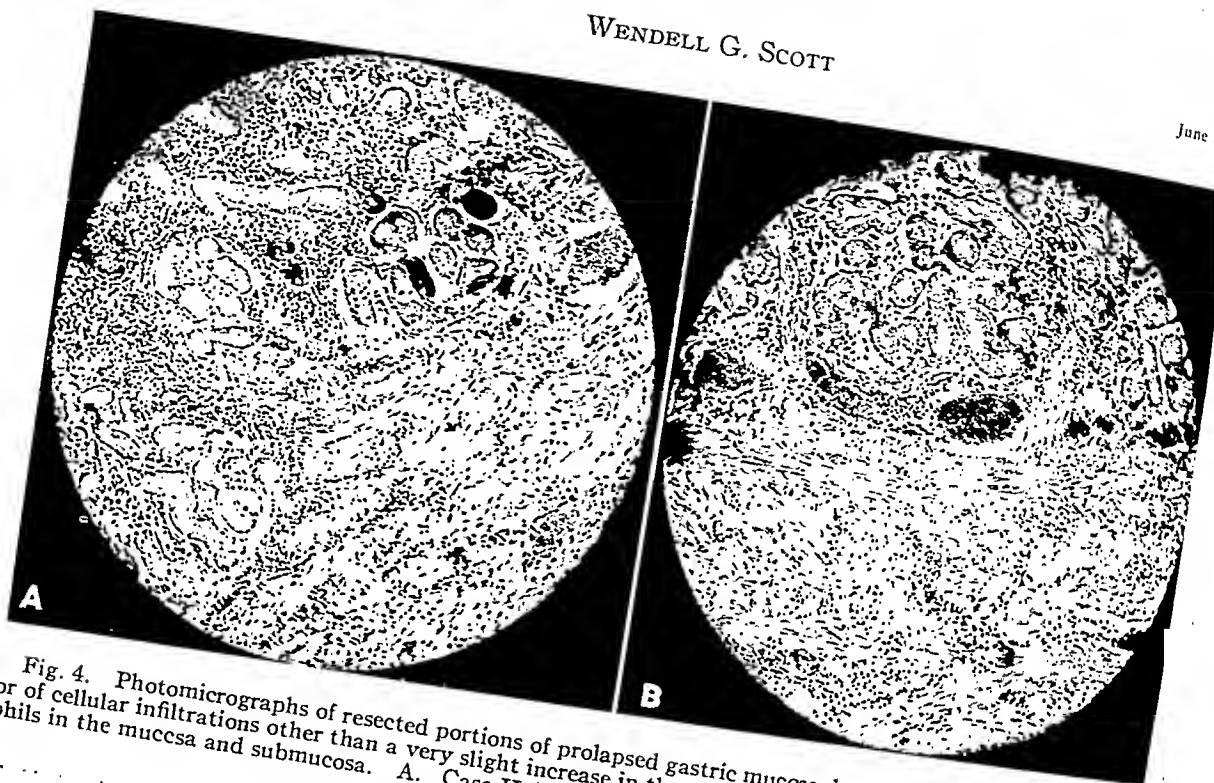


Fig. 4. Photomicrographs of resected portions of prolapsed gastric mucosa do not reveal evidence of a gastritis or of cellular infiltrations other than a very slight increase in the number of lymphocytes, plasma cells, and eosinophils in the mucosa and submucosa. A. Case II (see Fig. 8). B. Case III (see Fig. 9).



Fig. 5. The motility of the mucosa is illustrated in these films of the antrum of a normal stomach in which the pattern of the rugae is altered during different phases of peristalsis, as described by Golden. Both films are of the same patient and were made in the erect position within a few minutes of each other.
A. At this phase in peristalsis the rugae in the prepyloric portion of the stomach assume a transverse position.
B. During antral systole the rugae are stretched and run in horizontal rows at right angles to their previous position.

leads to hypertrophy, prolapse, and later polypoid degeneration.

Neither of these theories is fully supported by our studies. In the initial three patients, and in the subsequent two pa-

tients that required operation, there was no roentgenologic, gastroscopic, operative, or pathologic (gross or microscopic) evidence of a gastritis as suggested by Ellison's group. By the

was no evidence of a narrowing of the pyloric canal. The pyloric muscle was not constricted or hypertrophied.

At operation, the prolapsed portion of the gastric mucosa appeared as a loose "collar" of redundant hypertrophied gastric mucosa that had invaginated into the duodenum. Figures 1 and 2 are diagrammatic drawings of a large and a small prolapse of redundant gastric mucosa. The photographs and simplified tracings in Figure 3 demonstrate the prolapsed mucosa as seen at operation in Case 4. In the cases submitted to operation, the prolapsed portion of the gastric mucosa was not a finger-like projection of a single mucosal fold, but a rounded "collar." It could be forced back into the stomach but would protrude again as a long "rosette." The prolapsed folds appeared the same as normal mucosa to the unaided eye. They were soft and pliable—not fixed, thick, or indurated—and were in no way different from normal gastric mucosa other than being large and excessively mobile on the muscularis. No areas of erosion or ulceration were found, but these patients had been on a Sippy regime for some weeks prior to operation. The prolapses of the gastric mucosa were similar in the other four patients submitted to operation.

Microscopic examination of the resected gastric mucosa from the five patients operated on by Capt. Clyde Jensen (MC) U.S.N.R. revealed a slight increase in the lymphocytes, plasma cells, and eosinophils throughout the mucosa and submucosa, but not sufficient to warrant a diagnosis of gastritis (Fig. 4).

In an effort to correlate these findings and to explain the occurrence of prolapses of gastric mucosa, the problem was reviewed, and from a study of the anatomy of the stomach walls and of the physiologic movements of the mucosa on the muscularis, it appears that prolapses result from an excessive and abnormal mobility of the pyloric mucosa on the muscularis.

To review the anatomy of the stomach briefly, Cunningham's (3) and Gray's (13) textbooks state that the longitudinal fibers

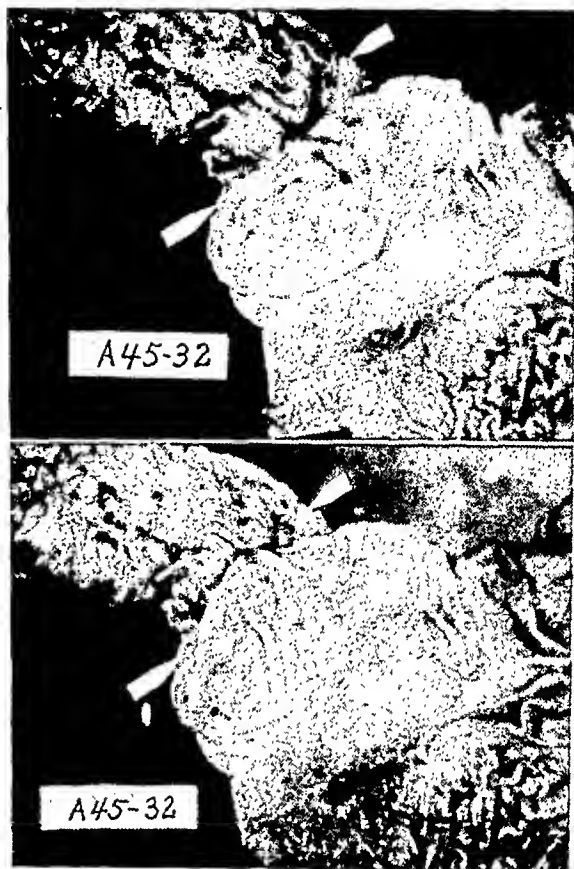


Fig. 6. An autopsy specimen of the antrum of a stomach in the prepyloric portion of which are large loose folds of mucosa or rugae. These were soft and flexible and could be moved manually over the muscularis for a considerable distance and easily pushed across the pylorus into the duodenum to simulate at least, if not actually produce, what we term a prolapse of the gastric mucosa. This specimen was obtained from a patient who died of severe cardiovascular disease and myocardial infarctions. Unfortunately, no roentgen examination of the stomach had been made.

A. The large folds of gastric mucosa arranged in the prepyloric area are all proximal to the pyloric sphincter, whose position is indicated by the white arrows.

B. The folds of prepyloric gastric mucosa were pushed across the pyloric sphincter and lie within the base of the duodenal bulb as is seen in prolapse of the gastric mucosa.

of the muscularis become much thicker and tougher and more closely united toward the pylorus. The more superficial fibers to a very slight degree pass onto the duodenum, but the deeper fibers dip into and interlace with the circular fibers of the pyloric sphincter. The circular layer of the muscularis increases in thickness at the pylorus and forms the bulk of the pyloric sphincter. These muscle fibers are sharply marked off from the circular fibers of the

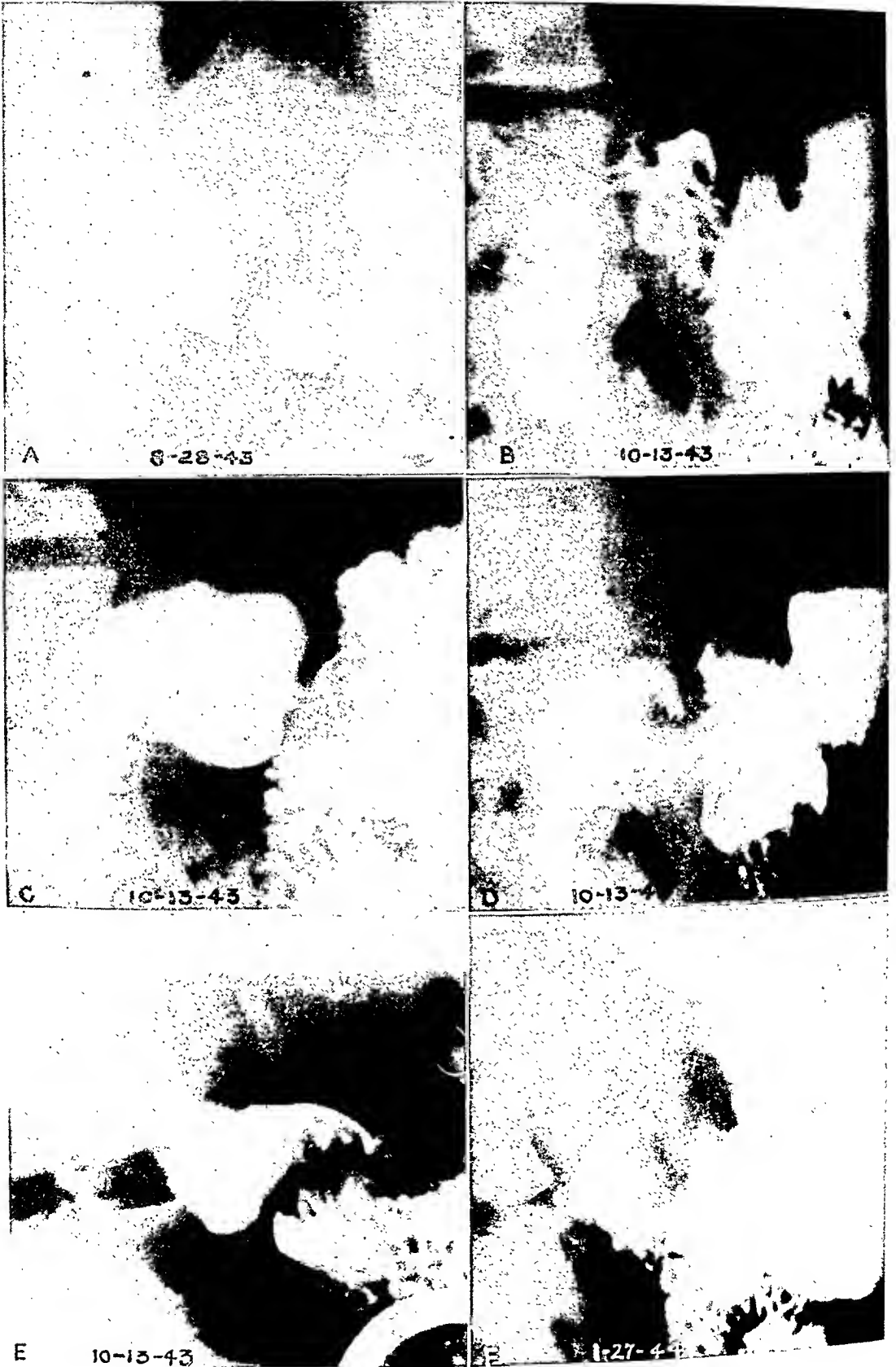


Fig. 7. Case I

For description and case history, see foot of opposite page

duodenum. Thus the fibers of the muscularis largely end in the pyloric sphincter, where they are firmly anchored and cannot prolapse (Figs. 1 and 2).

On the other hand, the mucosa is considerably thickened over the pyloric sphincter, where it forms a low fold, but continues into the duodenum without visible alteration or stronger connections with the underlying muscle. The mucosa and muscularis are not cemented together, but are connected by a soft, yielding submucosa composed of loose areolar tissue containing blood vessels, lymphatics, and nerves.

This construction of the stomach walls explains the limited mobility of the mucosa on the muscularis as found in all normal stomachs. The mobility is easily demonstrated in autopsy specimens by sliding the mucosa on the muscularis, and in living tissue by sliding the mucosa over the edge of the muscularis when the stomach is cut across at operation. Normally the extent of this movement is not sufficient to permit a prolapse of the mucosa through the sphincter into the duodenum.

Furthermore, the mobility of the mucosa is not only passive but, according to Forsell (9), it possesses an active movement, as folds may vary in size, shape, and position independently of the contraction of the muscularis. A similar movement was observed by Golden (10), who noticed that during antral systole folds of mucosa running transversely across the antrum were changed to run in neat horizontal rows parallel to the long axis of the stomach. To explain this change, he believed that it was necessary for the mucosa to move cephalad and become stretched on the muscularis. Otherwise, as the antrum closes off, the crisscross folds would be exaggerated, pushed downward, and jammed toward the pylorus. In support of his view, Golden cites Schindler's (21) gastroscopic observations that, during antral peristalsis, the antrum is shortened and the mucosa is arranged in radial folds. Golden mentions the possibility that the failure of this stretching mechanism may account for the herniation of prepyloric mucosal folds. The movement described

Fig. 7. A and B. Typical roentgenograms of marked prolapse of the gastric mucosa with "cauliflower-like" negative defect in the base of the duodenal bulb. The bulb has a perfect contour in C. Note the variation in the size and extent of the prolapsed gastric mucosa in A to E. The postoperative appearance, after resection and a pyloroplasty, is recorded on film F.

Case History: A 25-year-old sailor complained of intermittent attacks of epigastric pain for the past eighteen months. The pain came on about one hour after meals and was relieved by food and milk. He had been on combat duty and was wounded in the right forearm two months prior to admission. He was seen at a medical dispensary and sent to the hospital for study.

The first x-ray examination of the stomach was made on Jan. 8, 1943, and the report was that the duodenal bulb was deformed by an ulcer. The patient was placed on a Sippy regime which included seventy days of hospitalization. He showed moderate improvement and returned to duty. At the end of one week he re-entered the hospital because of persistent "gas" and epigastric distress. Following a second sixty-three-day ulcer treatment he improved but did not become asymptomatic.

On June 5, 1943, the patient returned to limited shore duty but after twenty-one days he was back in the hospital, complaining of almost continuous epigastric pain. The stools were negative for occult blood. Gastric analysis showed a peak of 11.2° of free HCl and a total acidity of 27.5° at one hour. A second x-ray examination of the stomach showed the duodenal bulb still deformed, but with less spasm and irritability. The Sippy treatment was continued for ninety days with little benefit. Because of persistent symptoms and the refractory response to medical treatment, an exploratory laparotomy was done on Sept. 15, 1943. The surgeon found the duodenal bulb normal. There was no induration, "stippling," or adhesions as evidence of a duodenal ulcer.

With this knowledge, the films were reviewed and it was apparent that the duodenal defect previously observed was due to a large prolapse of gastric mucosa. A third x-ray study of the stomach was done on Oct. 13, 1943, and confirmed the persistence of the prolapse.

A second operation was performed on Nov. 14, 1943. This time the bulb was opened and in its base a large "collar" of invaginated gastric mucosa was found. This was resected and the pylorus enlarged by a Finney pyloroplasty. No scars or ulcer defects were seen on the duodenal mucosa.

Following an uneventful convalescence, the patient was discharged to limited duty and has been able to do his job. He was last examined on Nov. 28, 1944, over one year after operation. At that time he was well, had gained 18 pounds in weight, and had been eating the regular Navy "chow." He has not been in a dispensary or hospital for treatment of any kind.

The case illustrates the persistence of symptoms and failure to respond satisfactorily to a carefully controlled ulcer regime which should make one suspicious of the diagnosis. Second, it demonstrates that the prolapsed gastric mucosa cannot be felt through the intact walls of the duodenum because the mucosa is not thickened, fixed, or indurated.

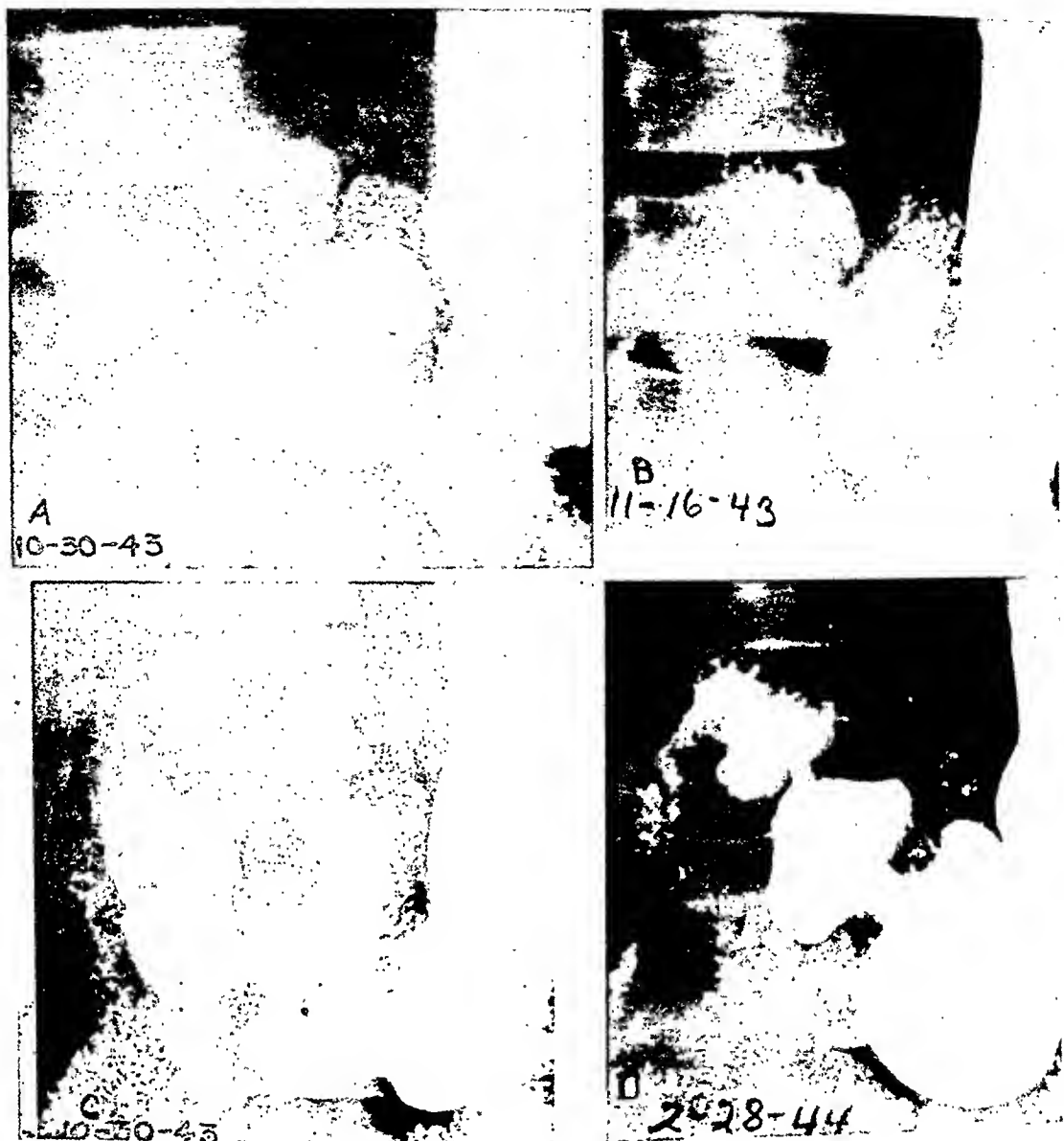


Fig. 8. Case II.

A and B. The prolapse of the gastric mucosa in this instance is more in the form of a large loose "collar" and produces what has been termed an "umbrella" type of defect in the base of the duodenum. This defect persists when the bulb is distended and can be seen through the overlying barium. D is the post-operative film, after resection of the prolapsed gastric mucosa and a pyloroplasty.

Case History: A 41-year-old chief yeoman entered the hospital on Oct. 27, 1943. In March 1941, he experienced attacks of epigastric pain before meals. They were relieved by food and occasionally by alkalies. X-ray examination of the stomach then revealed a defect that was interpreted as a duodenal ulcer and the patient was labeled with this diagnosis. A modified ulcer diet and regime made him comfortable for the next few years. In June 1941 he was retired to civilian life, but almost immediately he was recalled to active duty.

Until four to six months before admission he had been careful of his diet and got along fairly well. His work then became strenuous and required long hours. He neglected his diet, ate irregularly, and his symptoms were aggravated. The pain rarely woke him at night but was always present in the morning. He vomited occasionally. He had lost weight and was undernourished. The findings on physical examination were essentially normal and routine laboratory reports were all negative. The stools were twice positive for occult blood. On two occasions no free HCl was obtained, and the total acidity reached 13° in the fasting specimen, using histamine. Oral cholecystography demonstrated a normally functioning gall-bladder. A gastro-intestinal series on Oct. 30, 1943, revealed a large prolapse of redundant gastric mucosa into the duodenum. Repeat examinations, Nov. 16 and Dec. 18, showed the same findings.

The patient was placed under medical treatment on a Sippy regime, including bed rest, for seventy days, with some improvement, but not enough to return to duty.

(Legend cont. at foot of opposite page)

by him is illustrated in the films reproduced in Figure 5.

In the past twenty-one months, 126 stomachs were examined at autopsy for evidence of excessive mobility of the mucosa or a prolapse. In only one case (Fig. 6) was it possible to pull the gastric mucosa with surgical forceps through the pyloric sphincter into the duodenum to simulate a prolapse. In this instance, large redundant rugae were found in the prepyloric portion of the stomach. They were soft, flexible, and freely movable on the muscularis. These folds of gastric mucosa could be pushed across the pyloric ring into the duodenal bulb in a manner comparable to that seen in prolapses of the gastric mucosa at operation. The patient died from severe cardiovascular disease with myocardial infarctions. The record of a previous period of hospitalization included a history of dyspepsia and the description of an attack of epigastric pain with belching that was ascribed to a chronic cholecystitis, although no pathologic changes were observed in the gallbladder at postmortem. Unfortunately, there was no roentgen examination of the stomach. It is possible that the large loose folds of mucosa did prolapse into the duodenum, interfered with the proper functioning of the pylorus, and produced the gastro-intestinal symptoms. Little credence, however, can be given this one incomplete case. It is recorded here, as it is the only one in which a postmortem specimen was obtained approximating a prolapse of the gastric mucosa as seen at operation.

From a summation of the findings at

operation, the lack of pathologic infiltrations within the tissues, the anatomic construction of the stomach walls, and the passive and active movements of the mucosa, it appears that certain factors could influence or alter gastric peristalsis in a manner capable of bringing about sufficient stretching and loosening of the submucosa to provide the excessive mobility of the mucosa necessary for its prolapse or invagination into the duodenum. In other words, the structural conditions necessary for the development of a prolapse are inherent in the walls of the normal stomach, but a prolapse occurs only after the fibers in the flexible submucosa have been stretched and loosened by abnormal gastric peristalsis, which in turn is initiated by neurogenic or chemical stimuli or a combination of both.

Emotions such as worry, fear, excitement, and anger alter gastric function. Cannon (4) and more recently Wolf and Wolff (24) leave no doubt that emotions and the "state of well-being" enormously influence gastric peristalsis and chemistry. Wolf and Wolff even succeeded in producing ulcerations of the gastric mucosa by "worrying" their patients. Feelings of resentment or uncertainty or insecurity, of fretfulness, and of disappointment all have been heightened by the demands of the war and are reflected in gastric function. Similarly, "nervous" tension and "strain" have been intensified, and these also are capable of influencing gastric movements and chemistry. The irregular daily schedule of activities required in certain military and civilian occupations,

After a consultation with the surgical service it was decided that an exploratory operation should be done. On Jan. 4, 1944, Capt. A. M. French (MC) U.S.N.R. opened the duodenum and found, protruding into it, a large "collar" of prolapsed gastric mucosa. The "collar-like" mass of invaginated mucosa was resected and a Heineke-Mikulicz pyloroplasty was performed in closing the stomach. The duodenal mucosa and serosa were intact and free of any ulcer or ulcer scars. A cholecystectomy was also done because of adhesions about the gallbladder. The postoperative course was somewhat prolonged, as well as the period of hospitalization, as a full set of dentures was made.

Gastroscopic examination, postoperatively, by Capt. W. L. Voegtlin (MC) U.S.N.R. revealed no abnormality other than several mucosal hemorrhages in the antrum.

The patient was discharged to limited duty Aug. 30, 1944. He gained weight and tolerated a regular diet throughout his hospitalization without discomfort. Since then he has been subsisting partly at home and partly on regular Navy "chow" without a recurrence of symptoms. He has not missed a day at work and has received no medical treatment. He has gained 12 pounds in weight and feels well. He was last examined Dec. 13, 1944, about a year after operation.

This case again illustrates the importance of distinguishing between defects produced by ulcers and prolapses.

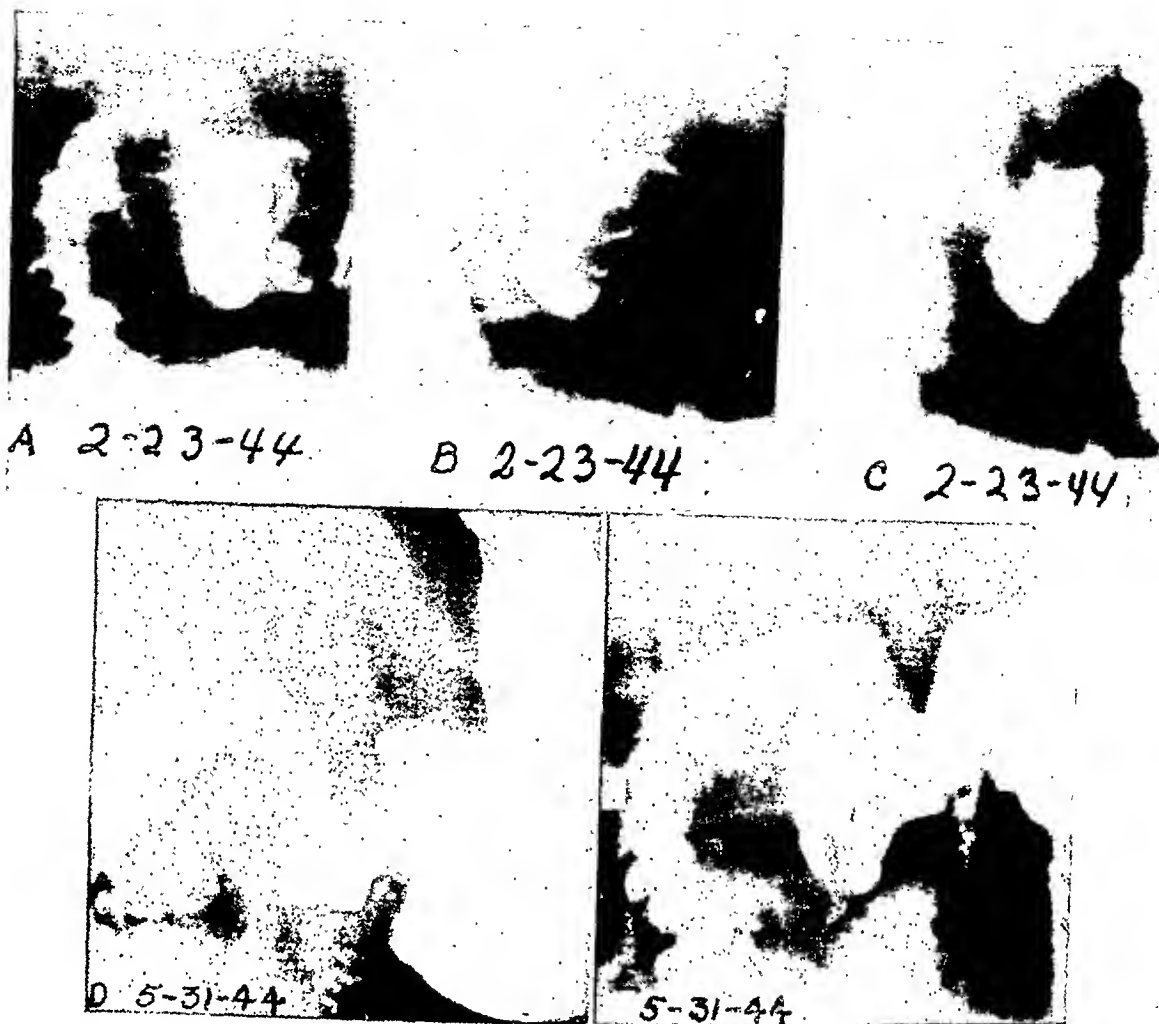


Fig. 9. Case III.

A, B, and C. A moderately large prolapse of the gastric mucosa fills the base of the duodenal bulb. Note particularly that the contour of the bulb is unchanged except at the base and, even when the bulb is distended with barium, the defect in the base can be recognized through the overlying contrast material. D and E are the postoperative films, after the prolapsed gastric mucosa was resected and a pyloroplasty performed.

Case History: This 34-year-old officer's illness began in February 1942 with "heartburn" and "acid stomach." The symptoms were unrelated to food but were partially relieved by soda and usually culminated in a feeling of weakness. At that time he passed two large tarry stools and was hospitalized for study.

An x-ray examination of the stomach revealed a deformed, slightly tender duodenal cap which was interpreted as indicating a duodenal ulcer, and this diagnosis was made a part of the record. Subsequent x-ray examination of the gastro-intestinal tract, two months later, showed the deformity of the duodenal cap still present. Improvement was observed on an ulcer regime, and the patient returned to duty at the end of six months. His symptoms disappeared except for occasional "acid stomach" that responded to crenalin or amphogel.

After a year on active duty at sea aboard a combat ship, the gastric symptoms reappeared. While on a short leave, the patient was examined by a civilian roentgenologist, who reported a deformity of the duodenal bulb but was uncertain that the defect was due to an ulcer. The officer returned to his ship, and by February 1944 his symptoms were severe and no longer relieved by alkalis. He complained of a "knotting up" of his stomach, with acid eructations and a feeling of illness after eating only small amounts of food. While aboard ship he had been working strenuously and for long hours. His meals were irregular for days at a time. He got little sleep and only short periods of rest.

The patient was now sent to the hospital for evaluation of the suspected ulcer and disposition. He was depressed and discouraged, as he felt that his career as a naval officer was jeopardized by his illness and that it was a handicap to his promotion.

The physical examination and routine laboratory findings were negative. Occult blood was found in the stools on three occasions. The gastro-intestinal examination on Feb. 23, 1944, revealed a large protrusion of the gastric mucosa into the duodenum. The gastroscope report of Capt. W. L. Voegtlin (MC) U.S.N.R. stated that the gastric rugae were large, and several of the folds appeared to extend into the duodenum. The remainder of the stomach was clear. The gastric acidity was within normal limits.

Because of the long duration and severity of symptoms, the persistent occult blood in the feces, and the opportunity of having the duodenal ulcer diagnosis removed from his record, the patient was operated upon by Capt.

[Legend cont. at foot of opposite page]

with disturbed rest, lack of sleep, excessive fatigue, and long periods of hunger, may be contributing factors. The excessive use of coffee, tobacco, and alcoholic beverages is well known to disrupt gastric function. Many of the factors just described entered into the experience of the patients in our series.

The one common denominator in the theories on the etiology of prolapse is an abnormal disturbance of gastric peristalsis and function. The most common, continuous, and effective means for altering gastric function springs from the emotions and the nervous system. Consequently, in view of the construction of the stomach walls, which normally permits a degree of mobility between them, it seems possible that certain neurogenic factors are the inciting cause of a disturbed gastric function that ultimately brings about a mucosal prolapse. A pre-existing disease process is not necessary for the production of a prolapse of the gastric mucosa.

SYMPTOMATOLOGY; PHYSICAL AND LABORATORY FINDINGS

The complaints of these patients are varied, being influenced by the extent and the condition of the prolapsed mucosa. The symptoms are not so stereotyped or characteristic as to permit a clinical diagnosis of the disorder. The diagnosis is made on the roentgenologic findings and the ruling out of other gastro-intestinal diseases. The symptoms recorded in the clinical charts were tabulated and are listed in Table II. The most common complaint was intermittent attacks of epigastric distress, cramp-like in nature, usually relieved by small amounts of bland foods or

TABLE II: MAJOR SYMPTOMS COMPLAINED OF BY PATIENTS WITH PROLAPSE OF THE GASTRIC MUCOSA

(Most patients had two or more of the symptoms.)

Intermittent epigastric distress; cramping pains...	14
Relief by food.....	10
Sense of fullness, bloating, heartburn.....	9
Nausea and vomiting.....	4

liquids, but seldom by alkalies. These symptoms closely resemble and in some instances are indistinguishable from those found in patients with peptic ulcer, duodenitis, and gastritis. This is probably due to the presence of very small superficial erosions or ulcerations on the prolapsed portion of the mucosa that has become irritated and edematous. This deduction is reasonable, since bleeding has occurred in some cases and a certain degree of erosion of the mucosa must have taken place for this to happen. Furthermore, the chemical factors in the duodenum are not favorable conditions for protruded gastric mucosa, nor is it in a desirable position, due to the "squeezing" action of the pyloric sphincter. Vigorous gastric peristalsis is usually present and accentuates these features. The intermittent character of the attacks, with intervals of freedom from symptoms and temporary improvement, is understood if one keeps in mind that the prolapses may occur intermittently and that the condition of the prolapsed mucosa may vary from time to time.

A "feeling of fullness" after eating even small amounts is a common symptom, probably due to an interference in the passage of food through a pylorus partially clogged with redundant mucosa. Nausea and occasional vomiting occurred in four patients.

The disorder should be suspected in patients with an atypical ulcer history, in

A. M. French (MC) U.S.N.R. on Feb. 29, 1944. The duodenal bulb was smooth and free of scars, adhesions, or "stippling" on the outside, and no evidence of a healed or active ulcer was found on the mucosa. Prolapsed gastric mucosa filled the base of the bulb. It, too, was free of ulcerations and was excised. A Heinicke-Mikulicz pyloroplasty was done in closing the stomach. The postoperative course was satisfactory, and the patient was on sick leave in two weeks.

On March 1, 1944, the diagnosis in his health record was corrected to prolapse of redundant gastric mucosa, postoperative. He was discharged on June 13, 1944, and returned to active duty as First Lieutenant and damage control officer aboard a cruiser, which is one of the most strenuous positions aboard a combat ship. A letter from his father, a Captain in the Medical Corps of the Navy, dated Sept. 12, 1944, stated that the ex-patient had been promoted to Commander and, to quote, "letters from Jack indicate he is in the pink of condition." Subsequent correspondence indicated that he had been symptom-free for almost a year.

The history of this officer illustrates the importance of accurately identifying a prolapse of the gastric mucosa and distinguishing it from a duodenal ulcer. This man's future was largely dependent upon the diagnosis of a condition which was amenable to surgery and permitted him to return to an active naval career.

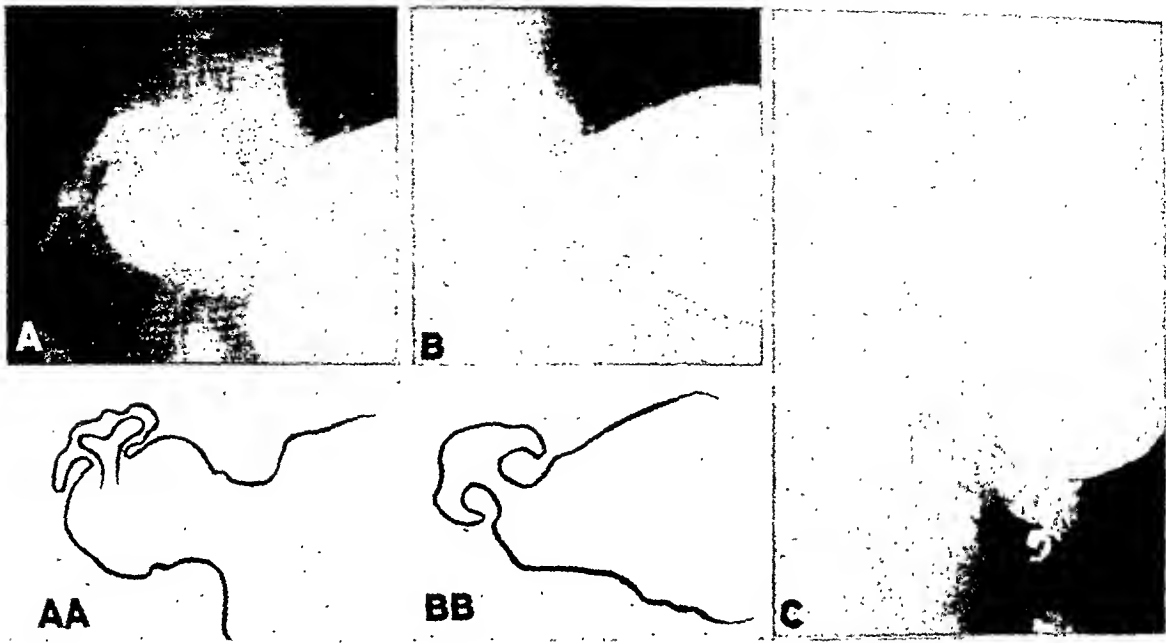


Fig. 10. Case IV.

A moderate prolapse of the gastric mucosa was demonstrated with difficulty in this patient, as his large size was almost beyond the capacity of the x-ray equipment. There was a constant negative defect, varying somewhat in size and contour, in the base of the duodenal bulb, due to a prolapse of the gastric mucosa, confirmed at operation (see Fig. 3). This case is not included in the original series, but is recorded here because it was confirmed by operation.

Case History: The patient was a 31-year-old seaman who had been in the Navy seven months and at sea for the past five and a half months. Shortly after he was assigned to a ship, he began having "stomach trouble" characterized by attacks of abdominal discomfort every three or four days. He described the distress as a "slow" pain in the lower abdomen, usually coming on about an hour after meals and lasting about thirty minutes. Alkalies did not relieve the distress. Food and milk were not tried. The pain did not waken him from sleep. He stated that he suffered from seasickness at times but thought his trouble was more deep-seated.

The attacks of abdominal pain became more severe, and on Sept. 17, 1944, the patient turned into sick bay. The entry in his health record read: "He vomited at noon and several times thereafter, the vomitus on one occasion containing approximately 250 c.c. of dark red blood." Physical examination was negative except for tenderness in the epigastrium. He was put to bed and given morphine.

Later that day the patient was transferred to a shore dispensary for observation. An x-ray examination of the stomach the next day was negative, and a tentative diagnosis of acute gastritis was made. After two weeks on a soft diet, the symptoms disappeared and the man was returned to the ship.

On Nov. 8, 1944, about two months later, the attacks of dull epigastric pain recurred and the patient was sent to this hospital for consultation and treatment. The physical findings and routine laboratory examinations were negative. Gastric analysis revealed a peak of 34° of free HCl at two hours. The x-ray examination of the stomach showed a deformity in the base of the duodenal bulb due to a prolapse of redundant gastric mucosa. Gastroscopic examination by Capt. Walter Voegtlin (MC) U.S.N.R. revealed a normal appearing stomach except for an excessive "rosette" formation about the pylorus during systole, which he considered suggestive but not diagnostic of redundant gastric mucosa.

A consultation was held with the surgical service. Operative treatment was advised because of the persistent symptoms, failure to respond to medical treatment, hematemesis, and the x-ray findings of a prolapse of the gastric mucosa. On Dec. 2, 1944, Capt. A. M. French (MC) U.S.N.R. explored the stomach and duodenum. A large protruding "collar" of gastric mucosa was found in the duodenum. This was photographed in still and motion pictures (Fig. 3). The redundant gastric mucosa was resected and the stomach closed following a Heineke-Mikulicz pyloroplasty. The postoperative course was prolonged by the development of pneumonia, but otherwise improvement was rapid. The patient has now been on a regular diet and free of symptoms for over six months.

those that do not make the usual response to an ulcer regime, in those with repeated recurrences when placed on solid foods, and in those with recurrent "functional complaints."

Reports of the physical examinations revealed no consistent abnormalities of significance other than tenderness in the

epigastrium on deep palpation. Absence of physical defects and disorders is to be expected among military personnel composed largely of selected young adults.

The routine laboratory examinations of the blood and urine were within normal limits. Secondary anemia due to prolonged bleeding was not found in any pa-

tient. The serological tests for syphilis were all negative. Over two-thirds of the gastric analyses were within the normal range or below, while one-third showed hyperchlorhydria. Occult blood was found in the stools of two patients.

Oral cholecystograms demonstrated normally functioning gallbladders in every instance. No abnormal lesions of the colon were detected with the aid of barium enemas.

Gastrosopic examination of the stomach was not available until the latter part of this study. In these patients examined by Capt. W. L. Voegtlin (MC) U.S.N.R. no consistent abnormalities were noted. In one case the appearance of the gastric mucosa was suggestive of hypertrophic gastritis, but not sufficiently characteristic to warrant that diagnosis. Positive recognition of folds of redundant gastric mucosa slipping through the pylorus was not obtained. The value of gastroscopy has been to rule out a gastritis as the cause of the symptoms. It should be done whenever practicable.

DIAGNOSIS AND ROENTGENOGRAPHIC FINDINGS

While the diagnosis of a prolapse of the gastric mucosa into the duodenum can be suspected from the clinical history, it is established by the roentgen examination. The appearance at fluoroscopy and on the roentgen film is quite characteristic and is easily recognized if one keeps in mind the pathology of the disorder and the following features:

1. The filling defects in the duodenal bulb due to the prolapsed gastric mucosa are invariably in the base, immediately around the pyloric opening. The redundant folds of mucosa within the bulb produce a central "mushroom-" or "cauliflower-like" negative shadow of a lobulated appearance (Figs. 7, A; 8, B; 9, A; 10, A; 11, A). Rarely, if ever, do duodenal ulcers produce a filling defect of this character (Figs. 12, A and 13, C).

2. The filling defects vary in size, shape, and appearance during a single examina-

tion and on repeated examinations, as the folds of redundant mucous membrane are soft and pliable. The degree and extent of the prolapse may vary from time to time or it may even become temporarily reduced during an examination or at later examinations. Such variations in contour and size are well demonstrated in Figures 7, 8, 9, and 11. These are the basic points in the roentgenologic differentiation from duodenal ulcers that are constant and unchanging at any one examination.

3. Usually the redundant gastric rugae can be traced from the antral canal through the pyloric opening into the base of the duodenal bulb. The prolapsed folds appear as wide dark spaces between the thin threads of barium that are in the valleys on either side (Figures 7, B-D-E; 8, A-B; 9, B; 11, C). Their visualization can sometimes be enhanced by exerting moderate compression over the pylorus and bulb. The rugae in the prepyloric portion of the stomach do not appear abnormal or particularly large.

Prolapses of the gastric mucosa must not be confused with a single prominent gastric ruga that is normally and frequently seen extending across the pylorus into the base of the duodenal bulb (Fig. 13).

4. With prolapse, the duodenal bulb is not "quick" or irritable and usually retains the barium, permitting prolonged examination, in contradistinction to the behavior of the bulb with an active ulcer or duodenitis. In all three disorders moderate tenderness can be elicited by deep pressure over the bulb.

5. Gastric peristalsis in most cases is more active and vigorous than is usually seen in the average patient.

6. No ulcer "craters," "niches," "incisura," or radiating rugae were seen in the central negative filling defects opposite the pylorus caused by the prolapsed mucosa. They should be sought, however, as Melamed and Hiller (14) report one case in which a large ulcer was demonstrated radiographically on the prolapsed mucosa and confirmed at operation. Rubin (20)



Fig. 11. Case V.

The typical negative "cauliflower-like" defect of a prolapse of the gastric mucosa is demonstrated in A and C. In B and D the defect is still present but has varied in size and contour, as the prolapsed folds are soft and flexible as well as partially reducible, as shown in D.

This case is not included in the original series, but is recorded because it was confirmed by operation.

Case History: A chief aviation radioman, 27 years of age, entered the Seattle Naval Hospital on March 6, 1945, complaining of recurrent attacks of epigastric pain over a period of seven months. They occurred at intervals of about two weeks, lasted four or five days, and then disappeared. Some attacks continued as long as two weeks. They usually began on an empty stomach and were temporarily relieved by food or alkalis. Highly seasoned or greasy foods caused increased discomfort. The patient vomited occasionally and upon one occasion thought the vomitus contained a little blood. His appetite was good and he had lost no weight. He had no bowel complaints. He had had three attacks of malaria, the first on June 7, 1943.

The patient was a well nourished and well built young man with no abnormal findings on physical examination. Routine laboratory procedures were within normal limits, including gastric analysis. Some benefit was obtained from a bland diet, but the patient never became symptom-free.

Prior to admission on Feb. 21, 1945, a diagnosis of prolapse of the gastric mucosa into the base of the duodenal bulb was made following x-ray examination at this hospital. This was confirmed on re-examination, March, 21, 1945. X-ray examination of the gallbladder showed normal function.

On April 3, 1945, a pyloroplasty was done, with removal of the redundant gastric mucosa, which had prolapsed into the base of the duodenal bulb. No evidence of duodenal ulcer or hypertrophic gastritis was found. The gastric rugae were large but soft and freely movable on the muscularis.

Pathologic examination of the resected tissue by Capt. Clyde Jensen (MC) U.S.N.R. revealed a mild infiltration of plasma cells throughout the mucosa and submucosa which microscopically resembled the changes seen in an early and mild gastritis.

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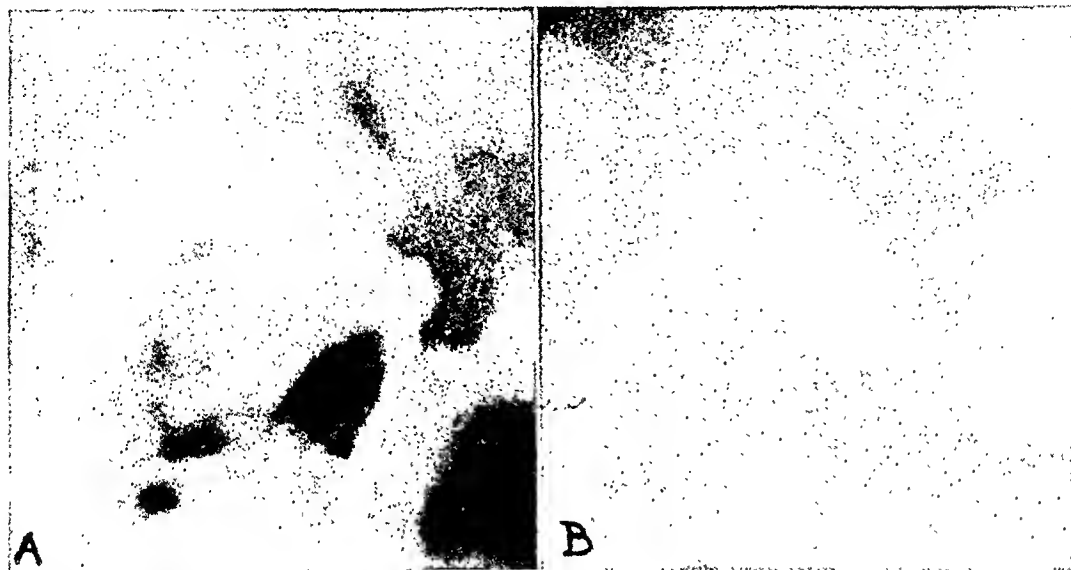


Fig. 12. Defects in the duodenal bulb that should not be confused with a prolapse of the gastric mucosa.

A. A duodenal ulcer in the base of the bulb does not produce a negative "cauliflower-like" defect but usually produces an incisura on the side of the bulb, as demonstrated here, or an ulcer crater, as shown in Figure 13, C.

B. Occasionally a basal view of the bulb pictures it as being smooth and concave with a narrow pyloric opening. This appearance of the bulb should be distinguished from that produced by hypertrophy of the pyloric muscle in adults, as described by Kirklin and Harris.

reported a case with proved malignant changes in the prolapsed polypoid mucosa.

7. Fluoroscopy supplemented by serial "spot films" is the method of choice for demonstrating prolapses, as a series of films is obtained at the moment the bulb and pylorus are best visualized. Films are also taken in various phases of peristalsis. It is essential that films be made in every case, since the filling defects caused by a prolapse can be overlooked at fluoroscopy, as has been pointed out by others.

8. In contrast to the experience of some, the prolapsed folds of gastric mucosa can be demonstrated with the patient standing, as well as in the prone position. No appreciable difference was noted in the appearance of the filling defects when small amounts of barium were used and large amounts, with the stomach fully distended.

In addition to duodenal ulcers, the filling defects produced by prolapses of the gastric mucosa must be differentiated from

other duodenal lesions. The diagnoses made on patients in this series prior to the recognition of the defect as being due to a prolapse of the gastric mucosa were as follows:

Gastric ulcer.....	1
Duodenal ulcer.....	11
Duodenitis.....	2

Most of the patients in the series had received a previous roentgenologic examination of the stomach and duodenum at which the above diagnoses were considered. These figures emphasize the importance for accurately recognizing prolapses of the gastric mucosa and distinguishing them from other disorders.

The most difficult lesions to differentiate are the *prolapsed pedunculated gastric tumors and polyps*. Those (15, 16, 17, 18) who have observed them were unable to distinguish them from prolapsed gastric mucosa with any degree of certainty, which is another reason for reporting the occurrence of gastric prolapses.

The patient was ambulatory by April 17, 1945, and although he experienced some pylorospasm, this was relieved by tincture of belladonna. On May 25, 1945, an x-ray examination showed a normally functioning stomach and duodenal bulb, with little deformity of the stomach due to the pyloroplasty. The patient was discharged to duty on May 28, 1945, without complaint and has gone along without symptoms on the regular Navy "chow" for over four months, with a gain of 17 pounds in weight.

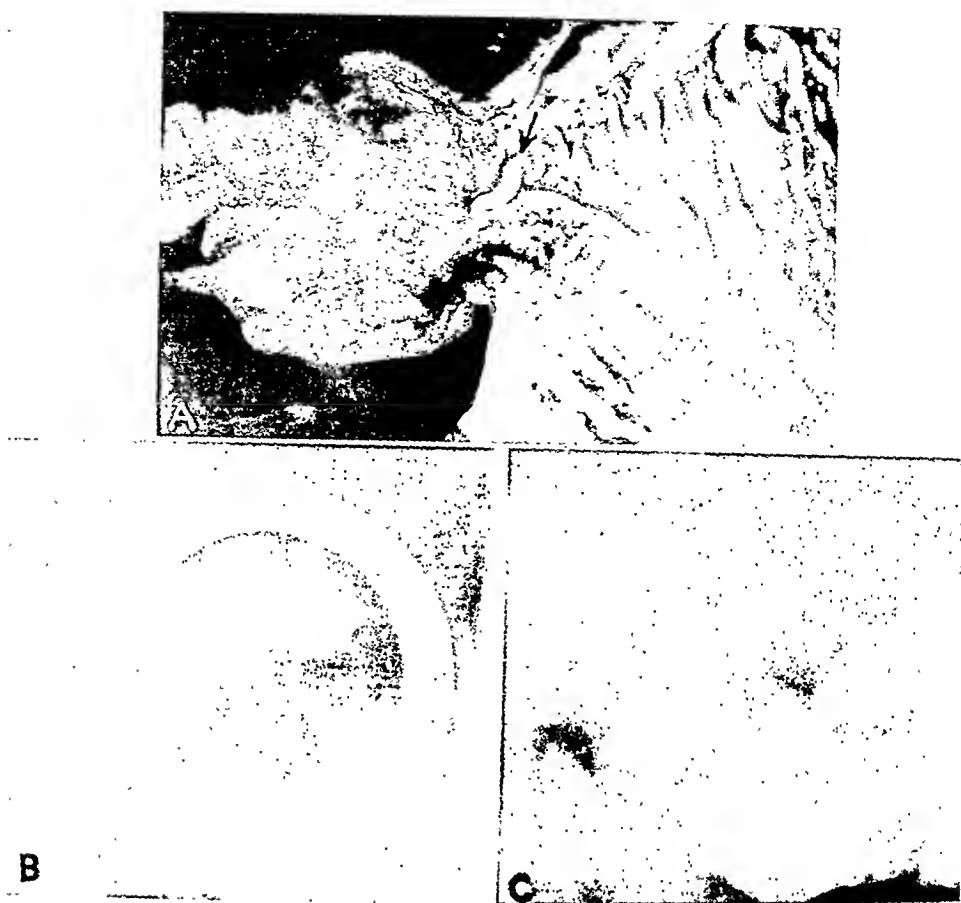


Fig. 13. A small fold of gastric mucosa is frequently seen in the pylorus extending into the bulb and is not a prolapse of the gastric mucosa.

A. Photograph of autopsy specimen which shows the anomalous fold of gastric mucosa on the posterior wall that is frequently found projecting into the duodenum.

B. Roentgenogram made antemortem, demonstrating the anomalous fold of gastric mucosa projecting into the bulb.

C. Duodenal ulcer with small crater, with the single gastric ruga leading nearly to it, similar to that in A.

Papillomata of the duodenum, as described by Waters (23) and Schons (22), produce filling defects that would be confusing. They appear, however, from reproductions to be larger and are not necessarily localized to the base of the bulb.

Duodenitis does not offer a difficult differential problem. Kirklin (11) describes the roentgen finding as a small, spastic, irritable, rapidly emptying duodenal bulb that varies in contour from moment to moment and possesses a coarse, irregular, reticular mucosal pattern—almost the opposite behavior from that of a gastric prolapse. In our experience the duodenal bulb in duodenitis is not always small, but may be of average size.

Hypertrophy of the pyloric muscle in

adults, as reported by Kirklin and Harris (12), produces an invagination of the base of the duodenal bulb similar to that of prolapsed mucosa, but this defect lacks the central negative shadow and lobulations of the gastric rugae (Fig. 12, B). Furthermore, with hypertrophy of the pyloric muscle the filling defect in the duodenum is constant in size and shape.

In the *hypertrophic types of gastritis* the rugae may become large enough to protrude into the duodenum and be indistinguishable from a slight prolapse. A gastroscopic examination quickly settles this differential diagnosis, showing the giant rugae mentioned by Kantor and the mass of redundant gastric mucosa described by Moersch and Weir. The same is true for

the idiopathic benign hypertrophic pyloritis of Cunha (6).

Normal variations in the appearance of the pylorus and the base of the duodenal bulb might be confused with slight protrusions of the gastric mucosa. To study these more thoroughly, radiographic examinations of the stomach were made in over 200 sailors and marines who had returned from combat and were free of gastric symptoms. They were on the surgical wards with fractures, shrapnel wounds, etc. The duodenal bulbs showing the largest irregularities in the base are reproduced in Figure 14. At the most, they exhibit a "puckering" at the opening into the duodenum or small indentations from the pyloric muscle. In this group, one duodenal bulb was found with a small deformity from a healed ulcer, but no prolapses of redundant gastric mucosa were present.

One type of normal variation in the appearance of the duodenal bulb that might be confused with a prolapse of the gastric mucosa is the normal concave shape of the bulb when viewed obliquely from the base, as shown in Figure 12, B.

The production of a prolapse of the gastric mucosa is necessarily a slow process if it takes place by any one of the suggested methods or combinations of them and, within limits, it is probably slowly progressive. It may be recognized by radiographic means in the early stages when the gastric mucosa first protrudes through the pylorus into the duodenum, as is seen in Figures 15, 16, and 17. It is the slight and moderate prolapses that form the bulk of this series and that most commonly produce the filling defects which are confused with those caused by duodenal ulcers and duodenitis. It is important that roentgenologists report these early protrusions so that the gastroenterologist can determine if they are causing symptoms. Thus a sufficient number of cases can be accumulated for proper evaluation as well as for autopsy studies.

CLINICAL EVALUATION AND TREATMENT

The clinical evaluation of patients with prolapse of the gastric mucosa is deter-

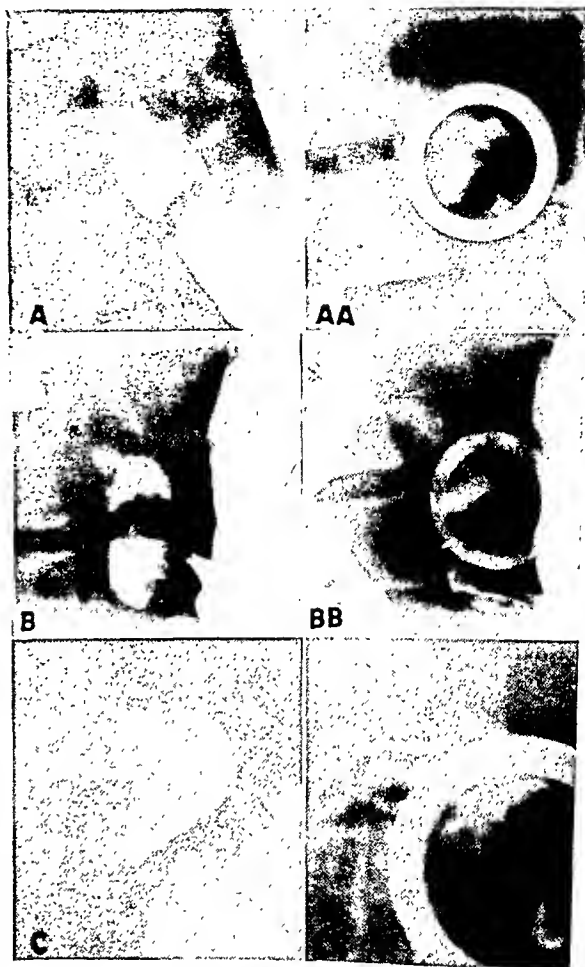


Fig. 14. In an effort to determine if prolapses of the gastric mucosa were present in individuals free of gastric symptoms, 200 consecutive marines and sailors who had just returned from combat duty with gunshot and traumatic injuries were examined without revealing an instance of gastric prolapse.

The duodenal bulbs in this figure are those which show the deepest irregularities at the base and are certainly normal. Each bulb is demonstrated without pressure (A, B, C) and with pressure (AA, BB, CC).

mined by the internist or gastro-enterologist in charge. The clinical work-up on our patients included the history, physical examination, and routine blood and urine analyses. Most of them had a gastric analysis, oral cholecystography, a barium examination of the colon, and a gastroscopic examination. If the symptoms were sufficiently severe or persistent or if bleeding or obstructive signs occurred, a consultation was held with the surgical service to decide if operative procedures were necessary. The cases were evaluated in this manner as follows:



Fig. 15. Case VI.

The films demonstrate the typical negative "cauliflower-like" shadow of a mild prolapse of the gastric mucosa. The protruding gastric mucosa is in the form of a collar, as shown by the multiple folds of gastric rugae.

Case History: On Aug. 22, 1944, a 38-year-old seaman presented himself at a medical dispensary complaining of epigastric pains of two months' duration. The pains had become progressively worse and were aggravated by fatty or greasy foods. No vomiting had occurred. The discomfort was not relieved by food or alkalies. That day the patient was transferred to the hospital. He had experienced similar episodes at intervals during the past two years.

The routine physical and laboratory examinations were negative. The gastric analysis showed a peak of 36° of free HCl at three hours and 50° of total acidity. X-ray examination of the stomach revealed a small defect in the base of the duodenal bulb that was interpreted as a prolapse of redundant gastric mucosa. The roentgen examination of the colon was negative. The gastroscopic study on Aug. 29 was negative. The patient was placed on a medical regime similar to that described in the text but made a slow response. He was subsequently transferred to a convalescent hospital for continued treatment.

Operated.....	3
Refused operation.....	1
Operation contraindicated.....	1
Surgery recommended for recurrence.....	2
Moderately large prolapses (total including those listed above).....	9
Slight prolapse.....	5

In 3 patients the symptoms were severe and persistent enough to require operation. Operation was recommended in one other

instance, but was refused by the patient. In still another it was considered advisable but was contraindicated because of a severe psychosis. Two patients were discharged with the recommendation that, if re-hospitalization became necessary due to a recurrence of symptoms or bleeding, surgical measures should be considered. A total of 9 had roentgen evidence of moderately large prolapses and 5 of slight.

PROLAPSED REDUNDANT GASTRIC MUCOSA

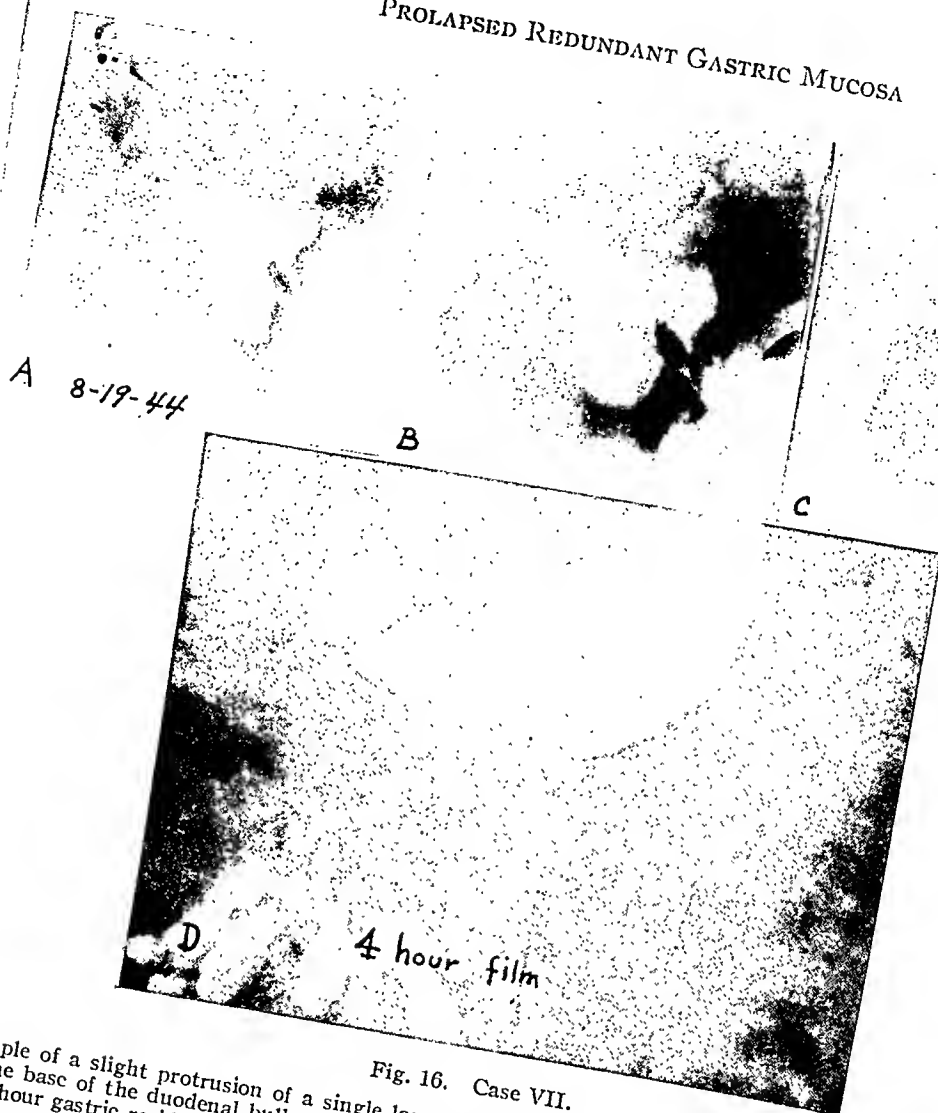


Fig. 16. Case VII.

An example of a slight protrusion of a single large gastric ruga. Note the constancy of the negative filling defect in the base of the duodenal bulb caused by this ruga. This patient was the only one of our series that had a four-hour gastric residue. It is possible that at times a fold of the protruding gastric mucosa becomes traumatized, swollen, and edematous from the passage of food and the action of the pyloric muscle. Such a mechanism would partially clog the pylorus and might be a factor in the production of gastric retention. "For the past month, epigastric pain, deep-seated, boring in nature, radiating upwards substernally and to the precordium; paroxysmal, lasting only a few moments at a time; not relieved by food but occasionally and to the precordium; paroxysmal, beverages in moderate amounts. About six months earlier a gallbladder examination was negative. Cardiac examinations were all negative.

The patient presented himself at the x-ray department for a complete gastro-intestinal series and for another oral cholecystographic test. The results were negative except for a small filling defect in the base of the duodenal bulb opposite the pylorus, which we felt was due to a small prolapse of redundant gastric mucosa. A previous roentgen diagnosis elsewhere had been duodenal ulcer. Gastric analysis revealed a peak of 54° of free HCl and a total acidity of 70°. The colon examination with a barium enema was negative. Gastroscopic examination was refused by the patient. He was placed on an advanced ulcer regime without alkalies, and gradually the attacks of epigastric pain subsided. Unfortunately, before a re-examination of the gastro-intestinal tract could be made, he was ordered to sea duty, which prevented further follow up.

In slight and in some moderate prolapses, frequent feedings and a bland diet similar to that of an advanced Sippy program afford relief. Hospitalization, with attention to rest in bed, relaxation, and freedom from tension, strain, fear, and worry, brings

improvement. Condiments, tobacco, alcohol, and caffeine should be eliminated. Mild sedation may be of value. These and other medical measures should be tried and when the patient becomes asymptomatic he may be returned to duty. He

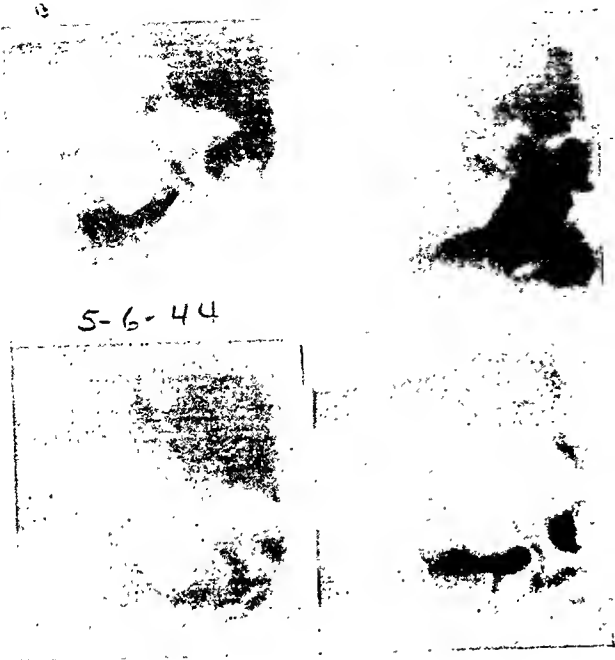


Fig. 17. Case VIII.

Slight to moderate protrusion of the gastric mucosa into the base of the duodenal bulb. The redundant gastric rugae are well visualized, protruding through the pylorus into the duodenum. No ulcer crater, niche, or incisura is present. This type of filling defect in the duodenum has been frequently interpreted as due to a duodenal ulcer, which it is not.

Case History: A 24-year-old seaman had been on duty in the South Pacific for seven months. In 1942, prior to enlisting in the Navy, he was told by a doctor that he had an ulcer. The doctor took no roentgenograms but put the patient on an ulcer diet, with improvement. He was sent into this hospital on April 7, 1944, complaining of epigastric pains and distress of two to three months' duration. The routine physical and laboratory tests were negative. Captain W. L. Voegtlin (MC) U.S.N.R. reported that the gastroscopic appearance of the stomach was normal. There was a slight gastric hypoacidity, with a peak of 27° of free HCl at the end of three hours. Upper gastro-intestinal series on April 12, 1944, and May 19, 1944, revealed a constant but slightly variable filling defect in the base of the duodenal bulb opposite the pyloric opening that was considered to represent a slight prolapse of redundant gastric mucosa.

In the summary of this patient's period of hospitalization, the gastro-enterologist expressed doubt that an ulcer had ever been present. The patient was given a leave transfer to another hospital with the recommendation that he be returned to full duty when asymptomatic. If a recurrence developed it was recommended that he receive a surgical consultation for consideration of the advisability of an exploration.

may then be able to get along by maintaining good dietary habits, obtaining adequate rest, and avoiding emotional upsets. If not, another period of hospitalization may succeed. Every patient with a prolapse of the gastric mucosa should receive the benefit of a trial on a medical regime before surgical measures are contemplated. Even

repeated attempts to control symptoms by medical means are well worth while. With further recurrences or with severe symptoms, surgical measures must be considered.

The large prolapses have always produced symptoms of sufficient intensity and constancy to warrant operative procedures. Large hemorrhages or repeated small ones are also indications for surgery. The same is true of the development of a partial pyloric obstruction with abnormal retention of the gastric contents.

The surgical procedures are not standardized but usually include a resection of the prolapsed mucosa and some form of pyloroplasty. Rees (19) recommends an antral gastrostomy, excision of the redundant mucosa, anchorage of the mucosa to the muscularis, and sectioning of the pyloric muscle. A practical point of interest to the surgeon is that the prolapsed mucosa is difficult to palpate through the intact duodenum and can be overlooked unless it or the stomach is opened for inspection (8, 19).

In the 3 patients operated upon in this series, and in the 2 cases that were operated upon later but are reported here, Capt. A. M. French (MC) U.S.N.R. resected the redundant mucosa and in the last 4 cases did a Heineke-Mikulicz pyloroplasty. On the first patient he resected the offending mucosa and did a Finney pyloroplasty. All the patients had uneventful postoperative courses and to date have been completely cured and able to subsist on regular diets.

COMPLICATIONS

Complications were present in 6 patients as follows:

Positive gastro-intestinal bleeding.....	3
Gastric retention.....	1
Coexisting duodenal ulcer.....	1
Coexisting gastric ulcer.....	1

In 3 cases physicians had recorded the occurrence of gross gastro-intestinal bleeding as seen in the vomitus or in tarry stools. Hemorrhage is an important complication

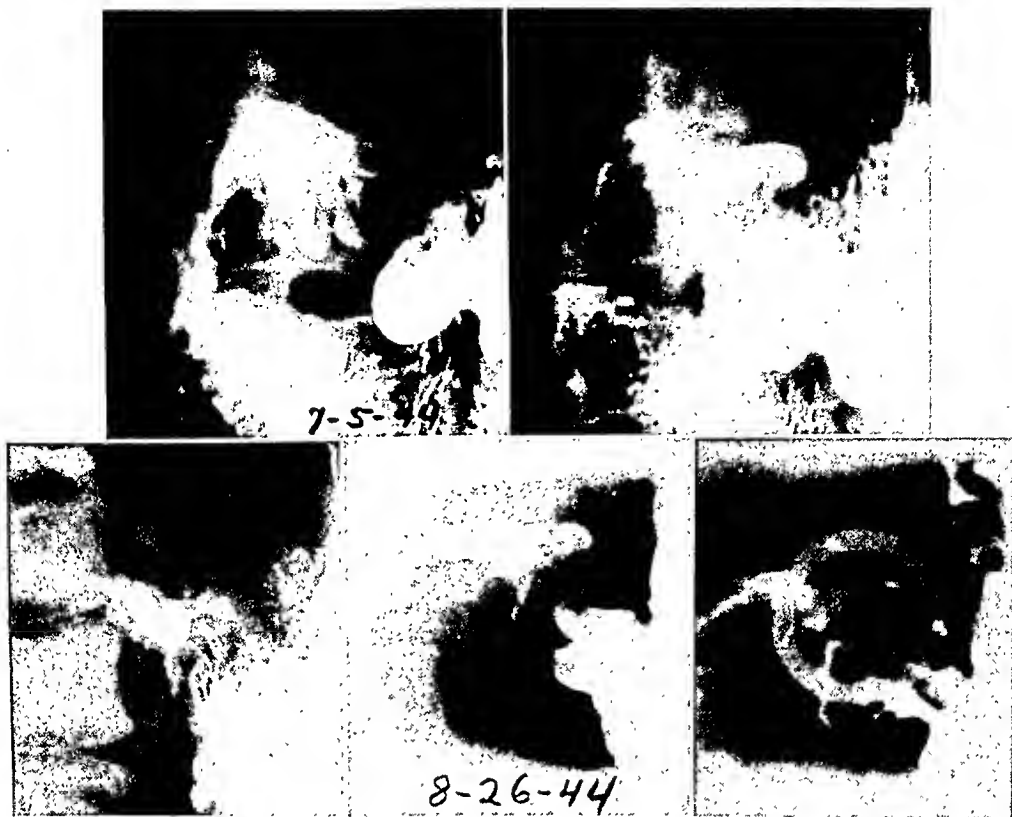


Fig. 18. Case IX.

A slight prolapse of the gastric mucosa into the duodenum occasionally occurs with a duodenal or gastric ulcer. In this patient the deep incisura from the scar of a duodenal ulcer was easily recognized, as well as the many redundant rugae in the base.

Case History: A 34-year-old seaman was admitted to this hospital on June 29, 1944, with the diagnosis of duodenal ulcer, which had been previously established from a roentgen examination. He had experienced intermittent attacks of epigastric pain for the last twelve years. The symptoms were about the same. Some seven years before admission he consulted a civilian physician, who made the diagnosis of ulcer. The patient has been on and off a Sippy regime as his symptoms varied in intensity.

A physical examination revealed no abnormal findings. The routine laboratory examinations were negative. A gastric analysis revealed a high of 58° of free HCl and a total of 70° combined at the end of two hours. A gastroscopic examination by Capt. Walter Voegtlin (MC) U.S.N.R. showed a normal appearing gastric mucosa.

After a period of hospitalization with considerable improvement, though the patient never became asymptomatic, he was surveyed by a medical board and discharged from the service.

and is not uncommon in the experience of others (1, 2, 7, 17, 18).

Gastric retention was present in only one patient with a moderate prolapse, although a 500 c.c. barium meal was used and the gastric motility film taken at four hours. In the cases reported by Archer (1) and Pendergrass (7, 17, 18), a gastric residue was a common and significant feature.

One patient with a gastric ulcer and one patient with a duodenal ulcer had prolapses of slight extent. The prolapses were regarded as incidental to the peptic ulcers,

although these patients did not become completely asymptomatic after healing of the ulcers as shown by x-ray examination.

SUMMARY AND CONCLUSIONS

1. Prolapses of the gastric mucosa are not rare. In a group of adult males prolapse of gastric mucosa occurred as frequently as gastric ulcer.
2. Prolapse of redundant gastric mucosa produces symptoms that may be suggestive but are not characteristic enough to permit a clinical diagnosis. The condition should be suspected in duodenal

ulcer patients with atypical histories, in patients that are refractory to an ulcer regime, and in those who have recurrences when placed on solid foods.

3. The diagnosis of a prolapse of the gastric mucosa is established largely by the roentgen examination. The filling defects are characteristic and should not be confused with those produced by duodenal ulcers, duodenitis, or other disorders of the duodenum and pylorus.

4. The typical filling defect in prolapse of the gastric mucosa is a negative "cauliflower-like" defect in the base of the duodenal bulb opposite the pylorus, varying in size and shape during a single examination and on repeated examinations. These defects can be overlooked at fluoroscopy and films should always be made. Fluoroscopy supplemented by "spot films" is the most desirable method of examination.

5. Since large prolapses of the gastric mucosa can produce symptoms, are a cause of gastric hemorrhage, and may result in a partial pyloric obstruction, the roentgenologist should be on the lookout for them, distinguish them from other duodenal defects, and report them to the referring physician for evaluation.

6. The treatment in early and moderate prolapses is medical until such time as repeated and severe attacks or complications occur. In the large prolapses and in those complicated by repeated hemorrhages or partial pyloric obstruction, surgical measures are indicated. They include excision of the redundant folds of mucosa and usually a pyloroplasty.

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Tuberculous Arthritis of the Shoulder¹

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THE INDIVIDUAL roentgen signs which characterize tuberculous arthritis are not, when taken singly, pathognomonic of the disease. When studied in the combinations and sequences in which they appear, however, they furnish sufficiently reliable evidence to permit an accurate diagnosis. The life history of a progressive tuberculous arthritis of the shoulder is presented. The roentgenograms are of interest because they illustrate many of the common denominators which characterize tuberculous arthritis in any joint.

CORRELATION BETWEEN THE CLINICAL, PATHOLOGIC, AND ROENTGENOLOGIC FINDINGS

Tuberculosis in a joint is a metastatic process. In the adult the primary source of infection is usually the lungs. In children it is almost always an infected lymph node (3). The metastatic focus may be in the synovial membrane or in the bone contiguous to it. The exact primary localization in the joint, however, appears to be of only academic interest. When the diagnosis of joint tuberculosis is made, both structures have already been invaded (1, 2, 6).

The insidious onset of tuberculous arthritis usually precludes early diagnosis. There gradually inserts itself into the consciousness of the patient an awareness of disability or pain. At this early stage tuberculous granulations may be present over the cartilaginous surface of the joint (4, 5, 6). The gross pathologic changes will be insufficient to be visibly reflected on a roentgenogram. There may result some clouding or an increase in the amount of fluid within the joint, but in many sites, as the shoulder or wrist (7), this may easily

escape detection. In any case these findings are not specific. Likewise, early osteoporosis is neither invariably present nor specific. It may be so slight that it will not be recognized without comparative study of an opposite or contiguous member. Narrowing of the joint space due to cartilage destruction is not a characteristic of early tuberculosis. Tuberculous granulation may therefore be present in a joint without giving sufficient or specific changes which may be demonstrated roentgenologically. Tuberculous arthritis is to be suspected in any patient with pulmonary tuberculosis who complains of prolonged disability or pain in a joint. A negative roentgenogram is by no means conclusive, and follow-up studies are indicated (Fig. 1). In children the clinical diagnosis may not be suspected until the roentgenograms are more characteristic.

As the process becomes more advanced, subchondral granulations develop, which undermine the joint cartilage at its attachment to the cortical bone (4). The cartilage may lie partly free in the joint space, but its destruction may be slow because of the absence of proteolytic ferments in tuberculous joints (4). Consequently the joint space may be maintained for an additional interval in spite of the presence of an active joint lesion. If there is beginning narrowing of the joint space, it is never of the degree which is commonly found with pyogenic infection at the same stage of disease. Concurrently, the contiguous underlying cancellous bone is involved in the morbid process (1, 2, 6). An important finding is the thinning or destruction of the bony articular cortex. Reactive periosteal changes or osseous productive changes are usually, but not invariably, absent. Osteo-

¹ From the service of Dr. A. L. Bachman (now with the Armed Forces), Department of Roentgenology (Dr. I. Startz, Director), Triboro Hospital for Tuberculosis, Jamaica, N. Y., Department of Hospitals, New York City. (The patient was on the service of Dr. L. H. Bennett.) Accepted for publication in July 1945.

porosis, whether due to bony atrophy or disuse, or to a combination of factors, including a possible specific tuberculous toxin (7), becomes more marked.

At this stage of the disease the clinical and roentgenographic findings are more typical. The joint pain and disability have persisted too long for casual observation. On the roentgenogram the partial destruction of the bony articular cortex will be visible. It is the first positive roentgen sign which indicates organic destruction at the joint. According to Phemister (4), this occurs from four to twelve months after the onset of the disease. While the osteoporosis may be vague, or the narrowing of the joint space absent or equivocal, the partial destruction of the bony cortex is a startling finding which cannot be disregarded (Fig. 2).

Inevitably, as the disease progresses, the opposing surface of the joint is invaded. At the shoulder, if the initial involvement was at the humeral head, the glenoid portion later follows a parallel morbid course. At the same time the slow destruction of the cartilage continues. There is no reason to expect an even destruction of articular cartilage, and the resultant narrowing of the joint space will not be uniform. Phemister (4, 5, 6) stresses the important role that the mechanical forces may play in determining the site and degree of cartilage destruction. When the tuberculous granulations overgrow the free cartilage surface, they erode it from the joint surface inward. Pressure from an opposing cartilage is said to prevent an overgrowth of granulation and therefore result in a longer preservation of that portion of the cartilage. In general, the areas of greatest pressure are usually in the central area of the joint. Ghormley, Kirklin and Brav (2) compared tuberculous with non-tuberculous diseased knee joints. They found that in non-tuberculous infections the greatest destruction is almost invariably central, while in the tuberculous cases it may be either central or peripheral. While mechanical forces may play an important role in determining the site and

rate of cartilage destruction, it would be futile to depend upon this as the exclusive explanation. Many factors, such as the virulence of the disease and the resistance of the local tissue, surely play a significant part. In any case, in the shoulder, where mechanical strains are more evenly distributed, the naturally haphazard spread of granulations is less affected by physical forces and the cartilage destruction appears to be without predictable pattern.

With the destruction of the cartilage, the narrowing of the joint space, and the invasion of the opposite side of the joint, there is a further increase in the involvement of the underlying cancellous bone. The cortex may now be almost completely destroyed. The contiguous bone is grooved and pitted. Irregular foci of rarefaction appear in the neighboring osseous areas (Fig. 3).

With a still further increase in the degree of invasion of the underlying bone, portions of it may become necrotic and sequester. The sequestrum may be delineated by a surrounding area of partial or complete rarefaction. Occasionally such areas of necrosis lie in opposition, on facing sides of a joint. They are spoken of as "kissing sequestra." The joint capsule is not immune and will eventually rupture. The joint detritus will then track through the perforation and gravitate along lines of least resistance. If the skin is perforated, secondary infection may result. The appearance will then become indistinguishable from that of other pyogenic infections. The destroyed joint relationships associated with muscle spasm will result in luxations and other deformities.

At this advanced stage the patient will not be able to raise the arm at the shoulder. Muscle wasting and spasm will be present. A soft-tissue mass will be palpable beneath the shoulder. The film will show complete destruction of the joint architecture. The joint space will be destroyed. Humeral luxation will be present. The underlying bone will show areas of necrosis and possibly sequestration. Rupture of the joint capsule will be indi-



Fig. 1. 4-17-1944: Tuberculous arthritis. Normal appearing shoulder which demonstrates that the presence of tuberculous arthritis cannot be excluded by a negative roentgenogram. The patient was a 54-year-old white male who had a far-advanced pulmonary tuberculosis. He had been complaining of shoulder pain for at least one month before this examination.

Fig. 2. 8-28-1944: Four months later the same shoulder shows clear-cut roentgenologic evidence of disease. The humeral head cortex is eroded with the exception of a fragmented shell, which is indicated by arrows. The joint space is slightly narrowed. No reactive changes are noted. The coracoid process is seen well through the osteoporotic head of the humerus.

Fig. 3. 1-17-1945: The disease has increased in severity. No part of the cortex of the humeral head remains intact. The osseous substance of the medulla has begun to erode. There is further destruction of the joint space. The kissing surface of the glenoid fossa is involved. Only a small fragment of cortical shell remains as indicated by the arrow. This appears to be sequestered. The scapula beneath the glenoid cortex is involved. Osteoporosis is more marked. No reactive changes are seen.

Fig. 4. 1-31-1945: Some luxation is present. A sequestrum appears to be present at the lower end of the glenoid. The bony debris which has resulted from the destruction of the osseous substance contiguous to the joint has collected in a dependent position, as indicated by the arrows. This could be felt as a painless fluctuant mass in the soft tissues at the upper end of the humerus. One month later the fluctuant mass was aspirated. The bacteriological smear was negative for pyogenic and acid-fast organisms. The culture was *positive* for acid-fast organisms. The patient suffered from a generalized hematogenous spread, as evidenced by the presence of laryngeal and epididymal tuberculosis, as well as tuberculosis in the opposite shoulder. He died two months after the last roentgenogram was made.

cated by a tracking of the debris to a point below the joint (Fig. 4).

DISCUSSION

No part of a joint is immune to tuberculous infection. If unchecked, the disease will ravage, with increasing severity, every portion of it. The encroachment does not proceed in stages and cannot be conveniently classified into exact pathological groups with corresponding roentgen findings. The rate of onslaught on the component joint structures varies among the joints, and from patient to patient in similar joints. There is some variation in children as compared to adults. It appears futile, therefore, to attempt a division of the process into definite stages where the roentgen appearance of the joint parts can be predicted. A knowledge of the morbid changes and the corresponding roentgen appearance of each part of the joint should, however, permit one to speak in general terms of early or advanced involvement.

The individual roentgen signs which have been described in this report have been studied by some authors who conclude that they do not occur exclusively in tuberculosis. While the individual signs are not pathognomonic, no false conclusions should be implied from this. When these signs are studied in the combinations in which they appear, they present enough accurate evidence to permit a confident diagnosis of tuberculous arthritis. The excellent studies in the bibliography are recommended with these thoughts in mind.

CONCLUSIONS

1. The life history of an actively progressive tuberculous arthritis of the shoulder is presented.

2. This illustrates, with slight variations, many of the common denominators which characterize tuberculous arthritis when found in any joint.

3. The following diagnostic features of tuberculous arthritis are demonstrated:

(a) A lag of roentgenologic evidence behind the clinical diagnosis. The first

roentgenograms appear to be normal, although tuberculosis is undoubtedly already present. The joint space remains intact because the cartilages are destroyed slowly.

(b) Cortical erosion. The intact cortex remains as a fragmented shell. Destruction of the bony articular cortex may be the first sign of organic destruction at the joint.

(c) Osteoporosis. This becomes very marked as the disease progresses.

(d) Later loss of joint space due to cartilage destruction.

(e) Invasion of the underlying cancellous bone.

(f) Involvement of the opposing surface of the joint.

(g) Absence of reactive changes (not invariable).

(h) Necrosis of the underlying bone with sequestra formation.

(i) Accumulation of debris.

(j) Rupture of the joint capsule and tracking of the fluid and debris, with cold abscess formation.

(k) Luxation of the joint as its destruction continues.

4. Many of the signs appear concurrently. They increase in intensity with the increasing severity of the joint involvement.

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Interarticular Isthmus Hiatus (Spondylolysis)¹

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ABNORMALITIES of the lumbar spine in respect to mechanical stability and functional capacity have been a matter of considerable importance to those concerned with industrial medicine. More recently they have assumed particular interest in the Armed Forces, for whom the correlation between structural variants of the spine and precipitation or development of "back pain" is a significant problem.

THE NORMAL VERTEBRA

Embryology (1, 9): At the second week of fetal life, there are two centers of chondrification in each vertebral body and one in each half of the incomplete neural arch. At the tenth week, the body shows a single center of ossification (at times two centers may appear). Concurrently, each half of the neural arch shows a single center of ossification. At birth, each lateral half of the neural arch consists of a bony plate united by cartilage with the body of the vertebra. During the first year of life, the vertebral arch forms as a result of fusion of these plates and gives rise to the spinous process. It is not, however, until the third year that the ossification of the neural arch and of the vertebral body becomes confluent. Full union of the primary centers is not completed until several years after birth.

Anatomy (7): The typical normal adult vertebra consists of two parts: an anterior segment, the body, and a posterior part, the vertebral or neural arch. These enclose the vertebral foramen. The vertebral arch consists of a pair of pedicles and a pair of laminae and supports seven processes: four articular, two transverse, and one spinous.

The pedicles are two short, thick processes which project backward, one on

either side, from the upper part of the body, at the junction of its posterior and lateral surfaces. The laminae are two broad plates directed backward and medialward from the pedicles. The articular processes, two superior and two inferior, spring from the junctions of the pedicles and laminae.



Fig. 1. Anatomical specimen, oblique view, showing interarticular isthmus and site of hiatus (arrow).

In the vertebra which shows the type of lesion with which we are concerned (Fig. 1), there is an hiatus between the superior and inferior articular processes. To this region, when intact, the term "interarticular isthmus" has been applied (3). The dehiscence itself might well be called the "interarticular hiatus." Such a term would be more specific in localizing the site of the defect than the term spondylolysis ("dissolution of vertebra"), an inclusive term which, by common usage, has come to connote this separation of the articular processes. The word hiatus is also to be preferred to other terms such as defect, etc., which are not adequately descriptive of the exact finding. A defect is any imperfection, blemish, or fault, whereas an hiatus is defined as a gap or fissure, which is exactly what we find in this condition.

¹ Work performed while the authors were in the Medical Corps of the Army of the United States. Accepted for publication in July 1945.

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HISTORY

In 1853, Kilian (11) first described the entity of "spondylolisthesis," giving to it that name of Greek derivation meaning "slipping of a vertebra." Credit for its widespread recognition must be given to Neugebauer (20), who, in the last decade of the nineteenth century, became interested in the subject. At that time, spondylolisthesis was the particular property of the obstetrician, who had noticed that, on occasion, it was responsible for hard and prolonged labor.

With the advent of the roentgen ray, the entity soon became the concern of the orthopedic surgeon. As hiatuses in the interarticular isthmus were more frequently detected, the relationship to spondylolisthesis was suspected. The mechanism whereby the hiatus was produced was a matter of much speculation, but no acceptable explanation was offered.

ETIOLOGY

The original postulate of Neugebauer as to the cause of the hiatus in the interarticular isthmus was based upon the concept that the arch, instead of developing from two primary lateral centers of ossification, developed from four, one for each pedicle and superior articular process, and one for each lamina and inferior articular process. He felt that it was the failure of the latter to fuse with the former that resulted in a congenital hiatus. This idea was attributable to earlier anatomical studies (22) which have recently been discredited by Willis (23), Mall (15), Batts (2), and Hitchcock (9). In extensive series, these authors were unable to find embryological evidence to substantiate the theory of a congenital hiatus. No one has ever reported an embryo which showed double centers of chondrification or ossification in each lateral half of the neural arch.

Some authors are of the opinion that a pre-existing fault between the superior and inferior articular processes is present. This defect is thought to be bridged by fibrous tissue in the newborn or very

young child. Then, when trauma in some form is applied to the spine, the fibrous tissue is ruptured. Subsequently, when healing takes place, they believe that callus will not form since cartilage rather than bone was present at the time of the injury. The existence of a congenital defect in the genesis of an hiatus is, however, not well supported by the evidence at hand.

Hitchcock (9), in a comprehensive report, offers some interesting experimental evidence from which the theory is derived that trauma applied in the form of hyperflexion during delivery or shortly afterward may be the cause. Carrying out an unstated number of experiments on still-born children varying in age from eight months to term and on infant cadavers up to ten months postnatal, he was able to produce a typical fracture of the isthmus by hyperflexion of the spine. Usually the fractures were bilateral, but unilateral fractures could be produced by combining flexion with lateral bending and torsion. These fractures passed through the predominantly cartilaginous portion of the isthmus.

This work has much to offer of itself, and it is supported by other well recognized facts. It is known that a fracture through cartilage will not produce callus but will heal by means of a pseudarthrosis such as we sometimes find with an interarticular hiatus. The presence of smooth edges and cortical bone along the line of fissure, as well as the uniformity of the gap, indicates that the fracture occurred prior to complete ossification. The most convincing evidence as to the time of occurrence of the fracture is the fact that the fault is never seen in the fetus and that it has been produced experimentally after birth by hyperflexion of the spine. The earliest authenticated age at which an hiatus has been found roentgenologically is seventeen months (12).

TYPES AND SITES

An hiatus across the interarticular isthmus may occur as an isolated finding or be associated with extensive separation of

the segments. In the latter instance, the part bearing the lamina and inferior articular processes moves backward while the rest of the vertebra, consisting of the body, pedicles, superior and transverse processes, slips forward.

The interarticular hiatus may be unilateral or bilateral and can occur in one or more of the lumbar vertebrae, including a sixth if present. It has been reported in the first sacral segment (10). The hiatus is most commonly seen in the fifth lumbar vertebra (88 per cent). In our series we have seen it in the third, fourth, and fifth vertebrae. Slipping forward of the spinal column has been described as occurring at all levels of the lumbar spine. The dislocation usually occurs so that the involved vertebra carries forward with it the vertebral column above. Rare instances in which the vertebra below has slipped forward have been reported (14) as well as "reversed" or posterior slipping (18).

The extent of slippage has been arbitrarily classified by Meyerding (19) as first, second, third, and fourth degree, or total slipping, depending upon the relationship of the posterior (or anterior) margin of the body of the involved vertebra to the corresponding segment below it.

INCIDENCE

At an Army Air Forces Regional Hospital where 511 backs were examined during the period of one year because of "back pain," 52 (10.1 per cent) showed definite roentgenologic evidence of an interarticular hiatus. Nineteen (36 per cent) of the 52 cases showed associated slipping of varying degrees. These figures are somewhat higher than those in other reports, since only patients with symptoms were studied. In the series of 1,520 skeletons examined by Willis (23), the incidence of isthmus hiatus was found to be approximately 5 per cent. In 2,000 cases reported in the literature, isthmus hiatus was found to occur in slightly more than 5 per cent (4, 9). The high incidence of interarticular hiatus among Army personnel with complaints of "back pain"

lays open the question of the significance of the interarticular hiatus in relation to spondylolisthesis and its correlation with the development of symptoms.

SIGNIFICANCE

The consensus of opinion is that an hiatus, as an isolated finding, is probably asymptomatic. The lack of symptoms does not, however, detract from its importance medically. Potentially, a vertebra with an isthmus hiatus may develop spondylolisthesis. This sequence of events has only recently been established. There are a few case reports in the literature with well substantiated evidence of progressive slipping (6, 9, 13). The specific factor in the development of spondylolisthesis is now thought to be trauma superimposed on the antecedent hiatus (9, 21). In 50 per cent of the cases, however, no history of trauma can be elicited. Whether the transformation occurs suddenly or slowly is uncertain. It has been suggested that a disturbance of the intervertebral cartilage plays a part in the dislocation of the vertebra. This concept has been touched upon in the past (8, 13, 16, 17); more recently, the role of thinning of the disk, as evidenced by x-ray, has been pointed out as a prominent feature (9).

Meyerding (17), in analyzing his series of 745 patients with spondylolisthesis, in the light of the newer knowledge concerning protruded intervertebral disk, found 80 who had symptoms of sciatica, and a much larger group who had vague pains and paresthesias of buttocks, hips, and thighs which might constitute a disk syndrome. He states that after he realized that a relationship might exist between an hiatus with slippage and disk protrusion, the incidence of a double diagnosis has increased considerably. In 15 out of 25 cases of spondylolisthesis associated with sciatica, the additional diagnosis of protruded disk was made. Six of the 15 patients were operated upon, and the diagnosis was confirmed (17). Recently Dandy (5) expressed the opinion that the symptoms of spondylolisthesis and defective

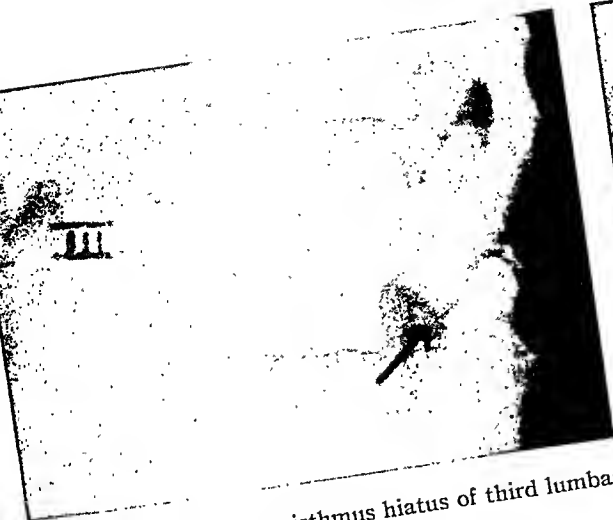


Fig. 2. Lateral view: isthmus hiatus of third lumbar vertebra.

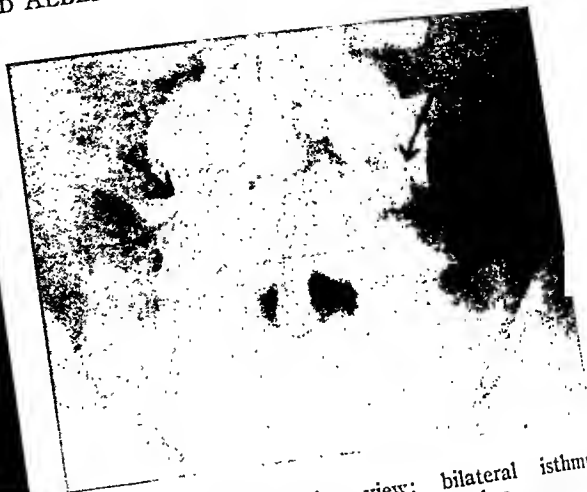


Fig. 3. Anteroposterior view: bilateral isthmus hiatus of fourth lumbar vertebra.

intervertebral disks are precisely identical and that the treatment is the same: *i.e.*, complete removal of the disk.

Whether there is a concomitant, precipitating, or sequential relationship is an interesting but merely speculative concept. On the basis of these reports, it is postulated that the presence of an isthmus hiatus provides an unstable spinal column which leads to injury of the disk. When degeneration of the disk takes place, the nucleus pulposus may protrude posteriorly, or shrinkage and subsequent decrease in the intervertebral space may permit slippage. The typical syndrome of back and leg pain associated with a protruded intervertebral disk or spondylolisthesis, or both, may be brought about. In the light of these possibilities the presence of a simple isthmus hiatus deserves more serious consideration than it has received in the past.

ROENTGEN FINDINGS

The conclusive finding is the demonstration by roentgenography of the hiatus itself. This is best demonstrated in the lateral (Fig. 2) or oblique view (Fig. 4) of the spine, whereby the isthmus is brought out in profile. Close inspection of a routine anteroposterior view (Fig. 3) of the spine often offers sufficient evidence to warrant the diagnosis.

A suggestive sign is the underdevelopment or posterior wedging (Figs. 5 and 6)

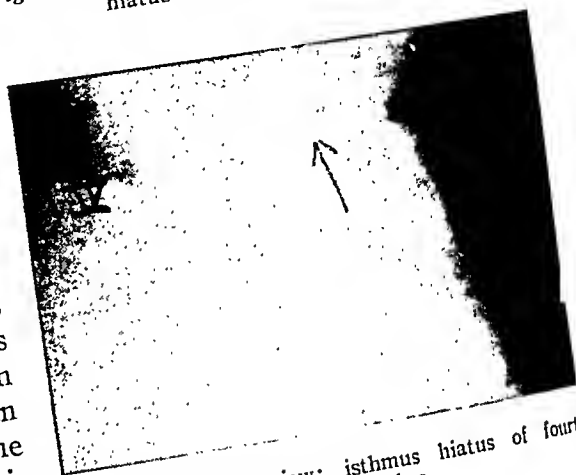


Fig. 4. Oblique view: isthmus hiatus of fourth lumbar vertebra.

of the body of the involved vertebra so that its height is less than that of the adjacent segments. Normally the vertebrae should become progressively larger as they near the sacrum.

Slippage in association with an hiatus is manifested by displacement of the affected vertebral body (Figs. 5 and 6). This is demonstrated by the abnormal relationship of its posterior margin to that of the segment below it. Normally, a line drawn along the posterior margin of the lumbar bodies should be continuous with one along the posterior margins of the sacral bodies.

Further evidence is an abnormal increase in the anteroposterior diameter of the involved vertebra as compared to adjacent vertebrae (Fig. 5). This diameter is measured from the tip of the spinous

process to the anterior border of the vertebral body. The increased value is due to backward displacement of the posterior segment (spinous process and inferior articular processes) or anterior displacement of the anterior segment (body, superior articular and transverse processes) of the affected vertebra, or both.

Additional evidence, occurring only in long-standing cases and probably nature's response in an attempt to prevent complete slippage, is the piling up of bone at the anterior lip of the sacrum, forming a buttress or ledge for a slipped fifth lumbar vertebra to rest upon (Fig. 6).

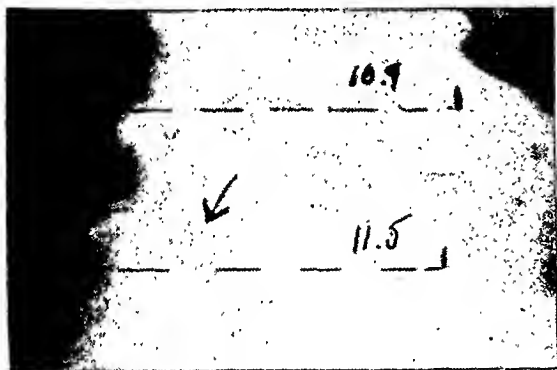


Fig. 5. Lateral view: underdevelopment, first-stage slipping, and increased total anteroposterior diameter of involved vertebra.

CONCLUSION

Although the evolutionary process of man is evidenced by anomalies of the lumbar spine, the vertebral interarticular isthmus hiatus (spondylolysis) does not fall into that category. It is probably the result of a hyperflexion injury or fracture through the cartilaginous isthmus sustained either at birth or shortly thereafter.

In a series of 511 backs examined because of the complaint of "back pain," 10.1 per cent showed an isthmus hiatus. Nineteen had associated slipping of the vertebra.

The postulate is offered that the presence of an hiatus affords an unstable state which may lead to degeneration of the intervertebral disk. When this occurs, either slipping of a vertebra or protrusion of the disk takes place. This leads to the

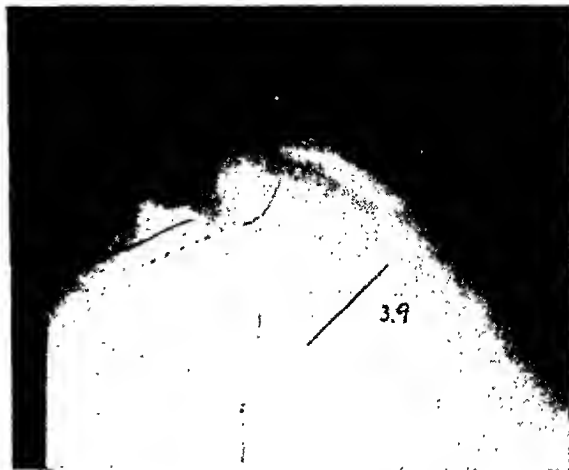


Fig. 6. Lateral view, illustrating slipping, buttress formation, and underdevelopment as evidenced by posterior wedging and decrease in size of involved vertebra.

typical clinical syndrome seen with either a protruded intervertebral disk or spondylolisthesis. The detection of a simple hiatus, therefore, deserves serious consideration.

The diagnosis of interarticular hiatus with or without slipping is based upon the roentgen findings, of which there are five:

1. Demonstration of the hiatus.
2. Underdevelopment of the vertebral body.
3. Displacement of the vertebra in relation to adjacent segments.
4. Increased total anteroposterior diameter of the vertebra.
5. Buttress formation at the anterior lip of the sacrum when the fifth lumbar vertebra slips.

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The Treatment of Carcinoma of the Cervix¹

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THE PAINSTAKING work of a few European and American institutions during the 1920's established the fact that the methodic and skillful use of radium in the treatment of carcinoma of the cervix yielded an appreciable percentage of five-year survivals in the operable as well as in the inoperable group (8). The use of radium in the treatment of early carcinoma of the cervix found rapid acceptance as the method of choice among gynecologists, radiotherapists, and surgeons. This was mainly due to the fact that, besides its effectiveness, intracavitary radium therapy could be practised with little risk according to standardized technics and also because the Wertheim operation even in the most skilled hands offered too high an operative mortality. In the treatment of the inoperable group of cases, by far the largest and most important, radiotherapy was early recognized as the only means of approach.

Obviously the results which have been subsequently obtained with varying technic and varied skills have not been at the high level of those which conquered for radiotherapy its predominant place in the treatment of this disease.

STAGE I

The Subcommittee on Radiotherapy of Cancer (Regaud, Heyman) of the League of Nations contributed a classification of carcinoma of the cervix in four stages which, as it stands after modification in 1937, constitutes our best present means of establishing a prognosis in this disease. According to this classification, now almost uniformly adopted, *only about 10 per cent of all cases of carcinoma of the cervix belong in Stage I*. That is, only 10 patients of every 100 present themselves with the

disease confined to the cervix, without invasion of the fornices, corpus, or parametria (Table I).

TABLE I: CARCINOMA OF CERVIX: PROPORTION OF CASES IN DIFFERENT STAGES*

(Report of Subcommittee on Radiotherapy of Cancer, League of Nations)

Stage I.....	607 cases	(11%)
Stage II.....	1,625 cases	(29%)
Stage III.....	2,417 cases	(42%)
Stage IV.....	1,020 cases	(18%)†

* 5,669 cases reported by nine institutions; 898 other cases, neither treated nor staged, mostly advanced cases, are not included.

† Classification of 1929, before its revision in 1937. The revision does not affect the proportion of Stage I cases. It will probably increase the number of cases in Stage II and reduce the proportion of Stage IV.

Recent advances in anesthesia and better knowledge of shock have justified a rebirth of enthusiasm for the surgical treatment of these Stage I cases. A marked reduction in operative mortality would become a very powerful argument in favor of surgery. Meigs reports a very low operative mortality but points to the unexpected high incidence (10 per cent) of injury to the ureter (7).

The occurrence of bowel necrosis has been mentioned as an unfavorable aspect of radiation treatment. Such complications do occur, but they are an exceptional, not necessarily fatal, untoward effect. These accidents vary greatly according to the technic. They occur most often after treatment of patients in advanced stages receiving a maximum of external and internal radiation. In such advanced cases the necrosis of the bowel usually accompanies a recurrence with pelvic infection and inflammation, which contribute as much to the necrosis as the radiation itself. In the treatment of the early cases, such accidents are avoidable through proper conduct of the treatment.

¹ Edited from a lecture delivered at the Barnard Skin and Cancer Hospital, St. Louis, Mo., Feb. 26, 1945. Accepted for publication in July 1945.

In more advanced cases they constitute a negligible risk.

Also, in support of the surgical treatment, it has been often said that cases clinically classified as Stage I may already have unsuspected pelvic metastases. The implication is that in such cases radiotherapy will fail and that surgery offers a chance. The percentage of Stage I cases which show metastases on pathological examination of the surgical specimens has been put rather high. Some authors have reported a strange adenoid arrangement of these "metastatic" cells (6). Actually such ring-like epithelial structures are found frequently in the pelvic nodes of normal women. They are in all probability fragments of normal endometrium which have been transported through the lymphatics in a true metastatic fashion, but they are unquestionably benign in nature (3). On a thorough pelvic examination, some cases of apparently early carcinoma of the cervix, without invasion of fornices or parametria, are found to have isolated pelvic metastases palpable against the pelvic wall. The League of Nations classification provides for the classification of such cases as Stage III. These metastases may be microscopic or beyond the reach of the palpating finger. When these early metastases occur, we are usually in the presence of a rather undifferentiated carcinoma, very radiosensitive, and biologically unfavorable to surgical treatment. The chances of success of the surgical treatment of carcinoma of the cervix rely on the possibility of complete removal of the tumor when this is strictly confined to the cervix. The additional removal of isolated nodes is a very unsatisfactory procedure, to say the least. *The occurrence of metastases in a small group of Stage I cases is, at best, an argument in favor of thorough external and internal irradiation, even in early cases.*

In 1938 the Subcommittee on Radiotherapy of Cancer, named above, reported the compiled statistics of results from nine institutions of Belgium, England, France,

Sweden, and the United States (4). These statistics represent an average of the poor results of early experimental years (1914) and better ones obtained through perfected technics (up to 1931). They are also an average of results of the different technics and the different quality of work in these several institutions. The compilation shows that the treatment of several hundred Stage I cases resulted in 55 per cent five-year survivals (Table II).

TABLE II: RESULTS OF RADIOTHERAPY IN 5,669 CASES OF CARCINOMA OF THE CERVIX TREATED IN NINE DIFFERENT INSTITUTIONS, FROM 1914 TO 1931
(Report of Subcommittee on Radiotherapy of Cancer, League of Nations)

	Cases*	Well 5 years†
Stage I.....	607	335 (55%)
Stage II.....	1,625	590 (36%)
Stage III.....	2,417	512 (21%)
Stage IV.....	1,020	52 (5%)

* Cases incompletely treated are included.
† Patients dead of intercurrent disease before five years were considered as failures.

It is unquestionable that the Wertheim operation, in skilled hands, yields a high percentage of five-year survivals. The disadvantages have been its operative mortality and morbidity. At the Barnard Skin and Cancer Hospital, 41 cases of carcinoma of the cervix, Stage I, were operated upon from 1928 to 1938. Thirty-three of the patients (80 per cent) remained free of disease five years after the operation. The operative mortality was 14 per cent. Only those cases which could not be operated upon because of obesity, hypertension, diabetes, cardiorenal disease, etc., were treated with radiations. The five-year survival in this last group of 27 patients was 60 per cent, a very good result considering the human material used (2).

But if isolated surgical statistics from outstanding centers compare favorably with the over-all average of results of radiotherapy, so also do the small series of results of radiotherapy in outstanding radiotherapeutic centers. Regaud (9) reported 28 cases cured (75.6 per cent) out of 37 Stage I cases treated from 1925 to 1929. Hurdon (5) reported 32 cures (80

per cent) in a group of 40 cases treated from 1934 to 1937. These two workers, incidentally, treated their Stage I cases with intracavitary radium therapy alone, without external irradiation.

STAGE II

When the carcinoma has extended beyond the cervix proper to the fundus, vaginal walls, or parametria, the chances of success of a surgical excision are greatly reduced. In most cases the operation would not be practicable. In the small number in which a Wertheim operation is technically possible, the operative mortality, the postoperative complications, and the chances of recurrence are considerably greater than in earlier cases.

The radiation treatment of Stage II cases carries few added difficulties. It must not be forgotten, however, that a Stage II tumor may be quite voluminous. Theoretically, a carcinoma of the cervix may have extended to the uterine fundus, infiltrated both parametria almost to the pelvic wall, and invaded the upper two-thirds of the vaginal tube, and still remain within the definition of Stage II. Intracavitary radium therapy alone may be successful in some of these cases, but the percentage of favorable results is increased when thorough external pelvic roentgen therapy has preceded the internal treatment. Regaud reported the comparative results of intracavitary radium therapy alone and in association with x-ray therapy (9). The five-year survivals in Stage II were 31 per cent and 46 per cent, respectively (Table III). The over-all average of results of radiotherapy in this stage as compiled by the League of Nations was 36 per cent five-year survivals.

Attempts have been made to combine radiation and surgical treatment in Stage II cases. Leveuf, Herrenschildt and Godard (6) advocated a dissection of the "principal" chain of lymphatics of the cervix. This is, by no means, a complete dissection of all lymphatics and their corresponding nodes. Taussig (10) applied this operation, which he called *iliac lymphadenectomy*,

TABLE III: VALUE OF EXTERNAL PELVIC ROENTGEN THERAPY

(Radium Institute, University of Paris—Regaud)

	Intracavitary Radium Therapy Alone (1919-29)		External Roentgen Therapy plus Radium Therapy (1926-30)	
	Cases	Well 5 years	Cases	Well 5 years
Stage II	175	54 (31%)	217	100 (46%)
Stage III	133	10 (7%)	226	77 (34%)
Stage IV	...	.....	24	2 (8%)

to the treatment of Stage II cases after external irradiation had been completed and before intracavitary radium therapy was instituted. Of 70 cases so treated, 46 had no node metastases. All that can be said is that in these 46 cases the operation was useless. Of the 24 cases which showed node involvement, only 5 (21 per cent) remained well at the end of five years. Such an elaborate combination of treatments would not be justified unless it raised the percentage of good results substantially. Actually, the percentage of five-year survivals (38 per cent) obtained by Taussig in the entire group compares unfavorably with the results in cases treated with radiation alone in other clinics, and is practically the same as the over-all average results of radiotherapy mentioned above.

STAGE III

When the carcinoma has invaded the pelvic wall on one or both sides, or the lower third of the vagina has been reached, the case is an extensive one. The percentage of cures, however, may be surprisingly high. To attempt to cure these cases with intracavitary radium therapy alone is to hope for the miraculous. To add inadequate external irradiation to the procedure changes the form but not the result. *If internal irradiation can be called the most important single factor in the treatment of early cases, a thorough external roentgen therapy is the most important single factor in the treatment of advanced cases.*

Baclesse (1) reported a series of 45 cases of advanced carcinoma of the cervix in Stages III and IV which received external

pelvic roentgen therapy alone. No internal treatment was given. Seven patients (15 per cent) remained free of disease at the end of five years. These patients received a very thorough external irradiation and obviously would have had a better chance if the treatment had been completed by internal irradiation. The series proves that external roentgen therapy is a powerful agent when judiciously used.

It is not our purpose to discuss here the details of technics of treatment. It suffices to say that in view of the attainable results there is ample place for serious consideration and improvement of present technics of external pelvic irradiation. The routine, inadequate, and insufficient external roentgen therapy which, too often, is given to these patients is a product of the lack of comprehension of the great possibilities of roentgen therapy in this group of cases. What is called a "frozen pelvis," with the stigma of incurability that hangs on it, is usually a curable Stage III carcinoma of the cervix. It is not generally realized that *a Stage III carcinoma of the cervix, competently treated, has a better prognosis than an operable carcinoma of the stomach*. The over-all average of five-year survivals as compiled by the League of Nations is 21 per cent for Stage III. Through better use of external pelvic roentgen therapy, the average clinic can improve its results in Stage II and Stage III cases. The improvement in the treatment of these two stages, which constitute three-fourths of all carcinomas of the cervix, may mean an additional salvage of between 15 and 20 cases in every 100, of all stages, receiving treatment. As a comparison, one may consider that in the treatment of Stage I cases a five-year survival of 80 per cent as compared with one of 60 per cent means only an additional salvage of 2 patients in every hundred cases of carcinoma of the cervix, of all stages, receiving treatment.

STAGE IV

When carcinoma of the cervix has invaded the rectum or bladder or extended

above or below the limits of the pelvis, the case is very serious indeed, but still not hopeless. Through painstaking effort a small number of these patients can be cured. Bladder invasion may occur rather early in the chronological development of carcinoma of the cervix. Patients have been cured in whom perforation into the bladder mucosa had already occurred.

In the treatment of Stage IV cases, the external pelvic irradiation will bear the burden of the effort and will be responsible for the results. Unquestionably, the large amount of care which is necessary will yield in the majority of cases only a transient palliation. The majority of patients will expire within a few weeks after the treatment, a few will survive for some months, but the small percentage of cases that will be permanently controlled makes the effort worth while.

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Some Experiences with Priodax¹

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PRIODAX OR β -(4-hydroxy-3,5 diiodo-phenyl)- α -phenyl propionic acid, became available for use in our hospital in May 1944. Prior to that date, various reports (1-6, 8) had appeared which led to the belief that the use of this new contrast medium was accompanied by no unpleasant symptoms, or at most by symptoms which were negligible. It was therefore decided to interview and record the reactions of the first 250 patients to receive Priodax for gallbladder examination and at the same time to study its efficacy for cholecystography.

The preparation of the patient was exactly the same as had previously been practised with sodium iodophthalein. The usual lunch was given on the day before the examination. The evening meal was fat-free. One hour after the meal, six Priodax tablets were given according to the instructions on the containers (1 tablet every five minutes, with a sip of water or fruit juice). The patient was permitted no breakfast on the following morning except black coffee or plain tea. He received a cleansing tapwater enema at 7 A.M., and the x-ray examination was done at 8 A.M. The single-dose method (6 tablets) was used throughout the series of 250 unselected cases.

After the completion of the x-ray examination, the patient was asked the following questions: "Did the tablets you took last night make you sick in any way?", "Did you become nauseated?", "Did you vomit?" Patients often volunteered the information that they had pains, cramps, dizziness, or headaches. They were then asked: "Did you notice anything unusual when you passed your water last night or this morning?", "Were your bowels affected in any way?", "Have you had your gallbladder x-rayed before?" If the answer to this last question was in the

affirmative, the patient was questioned as to what substance was used for the earlier examination, and whether it had made him sick or had upset him in any way. He was then asked which substance he would prefer to take if another examination should be required. The answers were recorded in tabular form with the radiographic results and, whenever possible, the results were compared with the answers given to questions relative to the examinations with iodophthalein.

Some of the observations are given in summary in the accompanying table, along with results obtained by other authors. It is obvious that the symptoms recorded are entirely subjective and that the degree of severity, as claimed by the patients, cannot be accurately compared. No effort is made, therefore, to grade the reactions into categories other than "severe" and "not severe." Nausea and dysuria were considered severe only when the patient voluntarily offered the information as such. Diarrhea varied from a loose bowel movement to eight watery movements. Three or more watery movements were considered a severe diarrhea.

Of the 250 patients, 23 per cent complained of nausea of varying degree, approximately 1 per cent vomited, and 43 per cent had loose bowel movements or diarrhea. Dysuria was experienced by 50 per cent of the patients, and 16 per cent had other symptoms, as pain, dizziness, headache, or a choking sensation. None complained of burning sensations in the throat. The outstanding difference in the results of this series of examinations, as compared to those previously reported, is the higher incidence of diarrhea and dysuria. Most of the previous reports record loose bowel movements or diarrhea in less than 23 per cent of those examined. No previous report has recorded dysuria as occurring in more than 20 per cent of the

¹ Accepted for publication in May 1945.

CASES SHOWING SIDE EFFECTS FROM USE OF PRIODAX AS REPORTED BY VARIOUS AUTHORS

Author	No. of Cases	No Symptoms	Nausea	Vomiting	Diarrhea	Dysuria	Pain	Comments by Authors
Bryan and Pedersen (1)	845	*	20%	2%	30%	12%	12%	.....
Dannenberg (2)	143	*	17%	3%	23%	17%	2%	"The major advantage of Priodax is the avoidance of any laxative action"
Hefke (3)	600	*	8%	1%	11%	3%	*	"Nausea, vomiting, and diarrhea are much less frequent than with tetraiodophenolphthalein"
Marshall (4)	50	*	0	2%	2%	4%	0	"It (Priodax) does not act as a purgative"
Ochsner (5)	300	56%	26%	3%	15%	5%	9%	.....
Paul, Pohle, and Benson (6)	114	*	28%	2%	23%	15%	*	"Burning on urination was of little consequence"
Vaughan and Eichwald (7)	163	19%	2%	*	5%	5%	*	"Diarrhea, nausea, and vomiting were infrequent"
Wasch (8)	134	32%	18%	0	13%	20%	7%	"Reactions have been negligible"
Present Study	250	14%	23%	1%	43%	50%	16%	"6% had severe nausea; 10% had severe diarrhea; 25% had severe dysuria"

* Not recorded.

patients; it was present in severe form in 25 per cent of the patients in this series, and in milder form in an equal number.

Whereas other authors (5) have reported no symptoms in as many as 56 per cent of their patients, in only 14 per cent of this series was there a complete absence of symptoms following the administration of Priodax. Of the 34 patients, however, who had both Priodax and iodophthalein cholecystography, 30 (90 per cent) expressed a preference for Priodax because of the ease with which it could be taken by mouth. Only one patient expressed a preference for iodophthalein, and three expressed no choice. In 14 of these 34 cases, films were available for comparison of the radiographic results. The results with Priodax were superior in 8 cases, equal in 5, and inferior in 1 instance. In 2 of the cases in which the results with Priodax were superior, the patients were unable to retain iodophthalein taken by mouth.

In this series of 250 cases, the gallbladder was well visualized in 89 per cent, faintly in 5 per cent, and not at all in 6 per cent. Cholecystectomy was performed in 6 of the 250 cases. In 4 of these cases, the gallbladders were visualized and contained non-opaque calculi; in 2, the gallbladders

were not visualized but calculi were demonstrated in the region of the cystic duct. In each instance, the operative findings confirmed the radiographic diagnosis.

From the radiographic standpoint, there were found to be two definite advantages in using Priodax. One is the lack of opaque material in the colon, which may obscure a part of the gallbladder, as in examinations done with iodophthalein. Another was the infrequency of faintly visualized gallbladders which required additional radiographic study.

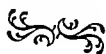
SUMMARY

In 250 examinations of the gallbladder, Priodax was found to be a satisfactory medium. It was more palatable than iodophthalein. Unlike iodophthalein, it rarely appeared in the colon and, therefore, rarely masked the gallbladder. The density of the shadow produced by Priodax was greater than that produced by iodophthalein, so that faint visualization was infrequent. The symptoms produced by the administration of Priodax, however, were not as negligible as previous reports indicated.

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Pancreatic Calculi as a Rare Cause of Intestinal Hemorrhage

Report of a Case¹

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THE PURPOSE OF this communication is to call attention to the fact that calculi of the pancreas can cause a fistula leading into the duodenum and result in the formation of a chronic peptic ulcer of the second portion. This ulceration may cause severe bleeding from the gastro-intestinal tract.

CASE REPORT

M. W. F., a 35-year-old man, had suffered attacks of diffuse upper abdominal pain for the past eighteen months. The pain had no relation to meals, was never agonizing, did not radiate, and was only occasionally associated with vomiting. Three months before admission the patient had two massive hemorrhages from the gastro-intestinal tract, with vomiting of blood and melena. Following this he was



Fig. 1 (left). Barium meal examination of upper gastro-intestinal tract made in September 1944, showing a filling defect of the second portion of the duodenum at its junction with the third portion. Note the calcific spherical density medial to the duodenal loop.

Fig. 2 (right). Roentgenogram of upper gastro-intestinal tract made in January 1945, again showing filling defect of the second portion of the duodenum with a small ulcer crater at the upper aspect of the defect.

Fanger (1) recently reported a case in which a pancreatic calculus eroded an artery in the region of the second part of the duodenum and caused a fatal hemorrhage into the bowel. In the case to be reported, pancreatic calculi eroded into the duodenum and produced a chronic peptic ulcer, which on several occasions caused massive hemorrhages. It would therefore appear that pancreatic calculi must be included in the differential diagnosis of bleeding from the gastro-intestinal tract.

very weak and a blood transfusion was given. Except for the melena following the hemorrhage, there had been no abnormality of the stools. There had been a loss of 35 lb. in weight in fourteen months. The remainder of the history was non-contributory.

On admission to the U. S. Naval Hospital, San Diego, physical examination revealed no abnormalities. Routine laboratory studies showed a slight secondary anemia with 3,570,000 red cells and 75 per cent hemoglobin. Urinalysis on one occasion showed sugar, but there was none in subsequent specimens. The blood sugar was 130 mg. per cent.

Oral cholecystography showed a normally functioning gallbladder. Fluoroscopic and radiographic examination of the esophagus and stomach was

¹ Accepted for publication in July 1945.



Fig. 3. Spot films of second portion of duodenum, showing defect on lateral side, with small ulcer crater at upper aspect of the defect.

negative, and the duodenal bulb was normal. A constant semilunar filling defect was observed on the right side of the duodenum proximal to the junction of its second and third portions. This defect measured 1.5×3 cm. and was smooth in outline except that at its upper aspect a small ulcer crater measuring about 4×10 mm. was found. The findings were interpreted as being consistent with a non-obstructing ulcerated benign tumor in the duodenum, apparently intrinsic and located at the junction of the second and third portions (Figs. 1, 2, and 3).

An additional finding was the presence of a radioopaque spherical shadow measuring about 1 cm. in diameter at the level of the inferior portion of the first lumbar vertebra on the right side. This shadow was definitely outside of the gallbladder and was not in the stomach or duodenum. It was interpreted as a pancreatic calculus or a calcified mesenteric lymph node (Fig. 4). A preoperative diagnosis of benign tumor of the duodenum, possibly a myoma

with ulceration, was made and operation was advised.

Through a right rectus incision, the upper abdomen was explored. There was a thickening of the wall of the second portion of the duodenum, most marked in its lower posterolateral portion. The entire pancreas was tense and swollen and its head was hard and enlarged to about twice the normal size. The second part of the duodenum was opened transversely at its mid-point and the interior explored. The ampulla of Vater was found and, by compression of the gallbladder, the common bile duct was proved to be patent. About 1.5 cm. lateral to the ampulla was a punched-out, chronic peptic ulcer penetrating all coats of the bowel except the serosa. The base of this ulcer was white and scarred. The incision in the anterior wall of the duodenum was extended laterally to allow excision of the ulcer. After the ulcer was excised, a fistulous tract or a duct was found extending medially from the ulcer site. A probe inserted in this tract en-



Fig. 4. Oral cholecystogram showing normal concentration of dye in the gallbladder. A spherical shadow of calcific density is seen to the right of the first and second lumbar vertebrae.

countered calculi. With some difficulty these were grasped with curved forceps and removed in small fragments. They were multiple and crumbled like old plaster (Fig. 6). After removal of the main mass of calculi there was a rush of pancreatic juice and flocculent material, indicating that the pancreatic duct had been completely occluded. All palpable calculi were removed and a probe could then be inserted as far as the tail of the pancreas. A catheter was inserted into the pancreatic duct to prevent its occlusion by sutures during the closure of the duodenum. This catheter was removed before the last few sutures were taken in the anterior duodenal wall. The abdomen was closed without drainage.

Convalescence was uneventful except for the development of a minimal infection of the wound. The abdominal pain present before operation did not recur, and the patient made an uncomplicated recovery and was returned to duty.

A roentgenogram made three weeks after the operation showed incomplete filling of the right side of the second portion of the duodenum which corresponded to the site of surgical excision of the ulcer and repair of the duodenum. A small streak of barium was seen to enter the pancreatic duct. The large calculus to the right of the first lumbar vertebra, previously described, was no longer seen. There was no evidence of obstruction (Fig. 5).

The pathologist reported that the tissue excised from the duodenum showed chronic inflammation with ulceration and no evidence of malignant

change. Analysis of the calculi showed them to be composed of calcium.

DISCUSSION

Although it is entirely possible that in this case the pancreatic duct opened separately into the duodenum 1.5 cm. medial to the ampulla of Vater, the chronic ulcer and the appearance of the tract leading to the



Fig. 5. Postoperative barium study of the upper gastro-intestinal tract, showing irregularity of the lateral margin of the second portion of the duodenum at the site of excision of the benign peptic ulcer. Note the small streak of barium extending into the pancreatic duct at the site of the removed calculus.

stones made it appear that this tract represented a fistula arising from the stones and extending into the duodenum. Such fistulae from pancreatic stones have been reported by Fanger (1) and Case (2), and in at least one instance the stones have been discharged through the abdominal wall. A second possibility is that occlusion of the pancreatic duct so diminished the alkali in the duodenum that the acid of the stomach was not neutralized and a peptic ulceration resulted. This possibility was demonstrated by Mann when he trans-

planted the pancreatic and bile ducts of dogs to the jejunum. However, the fact that the fistula led from the base of the ulcer to the stones makes it seem more likely that it originated at the site of the stones, penetrated the duodenum, and was converted to a chronic peptic ulcer by the action of the digestive juices. Erosion of a vessel was doubtless responsible for the hemorrhages.

SUMMARY

1. A case in which pancreatic calculi formed a fistula leading into the second portion of the duodenum is reported.
2. The mouth of this fistula had the appearance of a chronic peptic ulcer.
3. On several occasions massive hemorrhage occurred, presumably from the ulcer or from the fistulous tract.
4. Pancreatic calculi should be considered as a rare cause of bleeding from the upper gastro-intestinal tract.
5. Radiographically a benign ulcer of

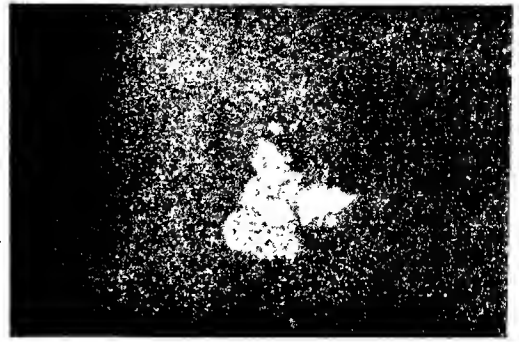


Fig. 6. Roentgenogram of the fragmented pancreatic calculus after removal.

the second portion of the duodenum may produce a deformity simulating a benign tumor with ulceration.

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Roentgen Demonstration of a Benign Intramural Tumor (Fibromyoma) on the Greater Curvature of the Stomach¹

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THE MORE COMMONLY encountered lesions on the greater curvature of the stomach are carcinomata and benign and malignant ulcers. The appearance of these lesions is well known to the roentgenologist. The roentgen demonstration of a benign neoplasm on the greater curvature of the stomach is less familiar. The incidence of benign neoplasms among all the gastric tumors varies between 1.3 per cent and 25 per cent according to surgical or postmortem studies. Among the benign neoplasms found on the greater curvature of the stomach, the leiomyomata are predominant, constituting 10 per cent of all benign gastric lesions. Reported instances of myomata on the greater curvature, with correlation of the roentgen and pathologic findings are few. The reason lies possibly in the fact that benign tumors of the stomach seldom give rise to sufficient symptoms to warrant careful roentgen examination or operation. In the case to be reported, the neoplasm was associated with gastric ulceration on the lesser curvature of the stomach. The symptoms produced by the gastric ulcer led to thorough roentgenologic investigation and subsequently to abdominal exploration.

REPORT OF CASE

The patient was a Norwegian seaman, aged 61 years. Aside from an acute neisserian infection at the age of 20 years, he had enjoyed good health up to about ten months before admission to hospital. Since that time he had suffered from intermittent abdominal distress, occurring after the ingestion of heavy food, particularly after dinner, and relieved by bicarbonate of soda or tincture of opium. The distress was described as a gnawing ache. Occasionally there occurred a more severe stabbing pain,

radiating from around the anterior-superior iliac spine on both sides up to both costal margins and across the upper part of the abdomen. There was no radiation of pain to the back. During certain periods the patient had frequent attacks of vomiting, but at no time was there any indication of hematemesis or melena. While ashore, and having access to milk and a lighter diet, he would feel better. His appetite throughout had been poor, and he had lost weight, from a normal of 76 kg. (167 lb.) to 56 kg. (123 lb.) at the time of admission. He had also noticed a pronounced loss of strength, having to rest frequently during regular tasks, which he had previously executed without any particular physical exertion. He had likewise been impressed by an increasing intolerance to heat in the engine room, by profuse perspiration, and by a certain tremor of the hands which made it difficult for him to write letters or perform finer manual tasks.

General Examination: The patient, who was found to be of the quiet, unassuming type, appeared chronically ill. The systolic blood pressure was 130 mm. Hg and the diastolic 90 mm. Hg. The heart action was rhythmic, 92 per minute. There was a fine tremor of the fingers and tongue. Peripheral arteriosclerosis of moderate degree was also noted. The skin was dry. The thyroid gland was not enlarged and there were no thyrotoxic eye symptoms. Careful abdominal examination revealed nothing of importance except slight tenderness to deep pressure in the mid-epigastrium. The physical examination otherwise was essentially negative.

Laboratory examinations revealed a normal urine, normal values for hemoglobin and number of leukocytes and erythrocytes. Extensive studies of the blood chemistry showed no abnormalities except the value for plasma cholesterol, which amounted to 330 mg. per cent. The fasting blood sugar was found to be 110 mg. per cent, and the values one, two, and three hours after the ingestion of the glucose for a routine tolerance test were 95, 89, and 70 mg. per cent, respectively. Following ingestion of the glucose solution, the patient perspired freely and there was tiredness indicative of a mild hypoglycemic reaction.

The gastric secretions indicated no free hydrochloric acid in the fasting specimen. Following a routine test meal, the acidity values increased to a maximum of 19 for free hydrochloric acid and 33 for

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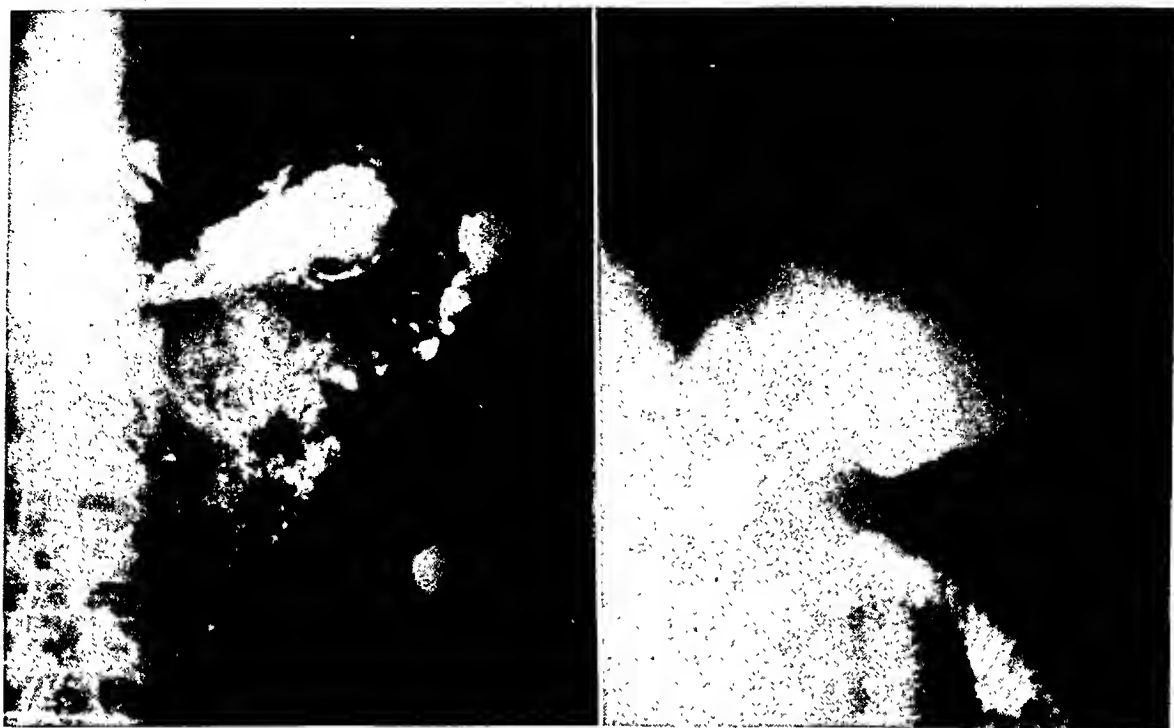


Fig. 1. Routine prone mucosal view and oblique view of the stomach filled with barium, which fail to disclose any definite abnormalities.

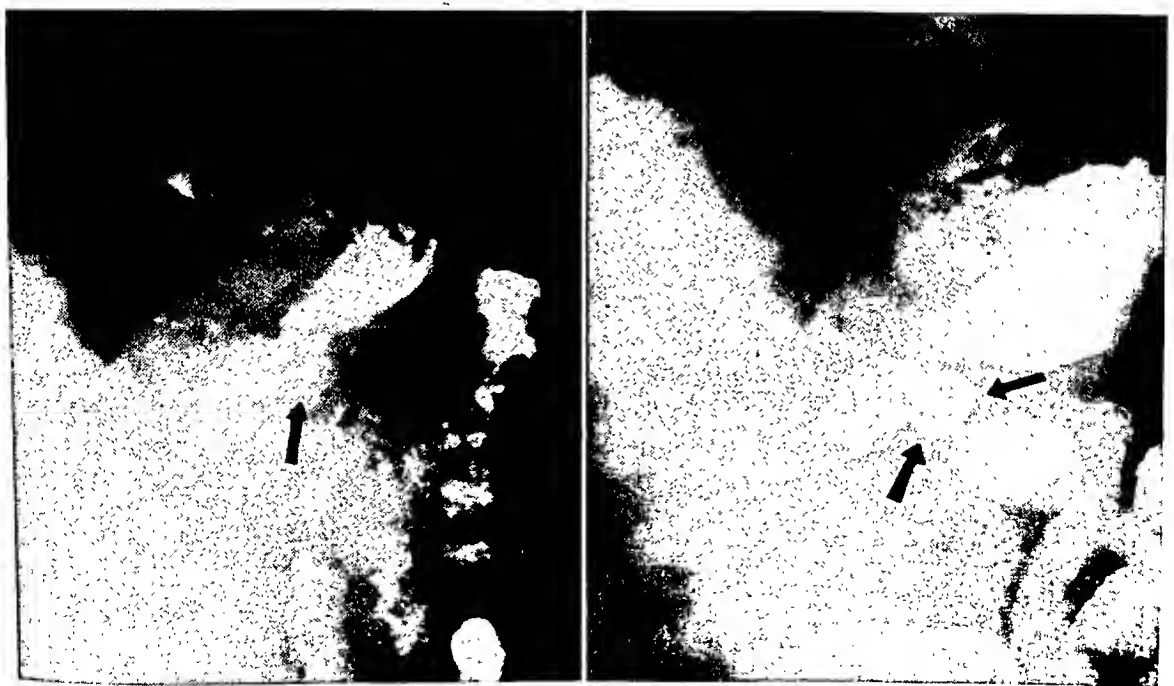


Fig. 2. Mucosal view with minimal rotation in the right oblique, showing accumulation of barium in an area devoid of serrations. The same projection with filled-organ technic shows the contraction of the entire involved area.



Fig. 3. Erect oblique and erect lateral studies showing the absence of serrations in the involved area.

total gastric acidity after thirty minutes. Repeated examinations of the stool for occult blood proved negative. The basal metabolic rate was -20 . The Wassermann reaction was negative.

We shall not discuss the various differential diagnostic problems which presented themselves. Suffice it to state that the patient was placed on a milk diet, to which were gradually added lighter digestible foods as his well-being improved. He was likewise given thyroid medication. Finally, he was dismissed, greatly improved, to a convalescent home June 19, 1944.

In view of the well known fact that a patient past sixty years of age might well be harboring a gastric carcinoma in spite of a satisfactory improvement in his general condition on a medical regimen, a return for an exploratory laparotomy was advised, should symptoms recur.

On Nov. 16, 1944, the patient was readmitted. He had felt very well up to about seven weeks before his return, when there had been recurrence of abdominal symptoms identical with those previously experienced. During the last two weeks before admission, however, there was radiation of pain to the back and frequent attacks of vomiting had occurred, although there were no indications of gastro-intestinal hemorrhage.

The x-ray study (Lewitan) prior to admission had shown a loss of normal serrations on the greater curvature of the stomach in an area measuring about 4 cm. This area was separated by smooth margins

from the remaining part of the greater curvature of the stomach, which appeared normal. This finding was constant, but could be obtained only on minimal rotation in the right oblique projection. On the prone mucosal studies no abnormalities were noted. Lateral views and other oblique views also failed to present any abnormal findings. In the 15-degree oblique projection, using the filled-organ technic, one could see the entire involved area contract as a whole. The indentations proximal and distal to the involved portions of the stomach were very deep and an incisura effect was thus produced. In the erect position, a semicircular area opposite the incisura angularis was noted, corresponding in size to the lesion as demonstrated on the mucosal studies. The roentgen appearance was rather bizarre. It was felt, however, that a benign ulceration or a benign tumor was the most likely diagnosis.

The findings on physical examination at this admission did not differ essentially from those at the first admission, except for a pronounced tenderness to direct pressure over the entire epigastrium.

On Nov. 20, 1944, operation was performed (Nygaard). Careful intra-abdominal exploration revealed no demonstrable pathologic changes except those referable to the stomach. High on the lesser curvature an induration could be palpated. This was adherent to the underlying peripancreatic capsule. Along the major curvature, opposite the incisura, a well limited single tumor of elastic hard consistency, about half the size of a walnut, could be



Fig. 4. The appearance of the resected specimen with the tumor, from the mucosal and serosal surface.

palpated. No nodes were noted along the lesser or major curvature. A subtotal gastric resection with a posterior Polya anastomosis was performed.

The proximally located induration proved to be a benign gastric ulcer of the perforating type. The single tumor along the major curvature was found to be entirely intramural, stretching the serosa and normally preserved mucosa over its slightly bulging anterior and posterior aspects. Because of this bulging, the mucosa appeared stretched out over the tumor, thereby losing its rugae. The microscopic examination proved the tumor to be a fibroma with a few strands here and there of myomatous tissue.

The patient underwent an uneventful recovery and was dismissed from the hospital Dec. 11, 1944.

SUMMARY

The roentgen findings in a case of fibromyoma of the greater curvature of the stomach are presented. The patient's symptoms, on clinical examination, were due to a shallow ulceration on the lesser

curvature of the stomach. This was associated with absence of free hydrochloric acid in the fasting specimen.

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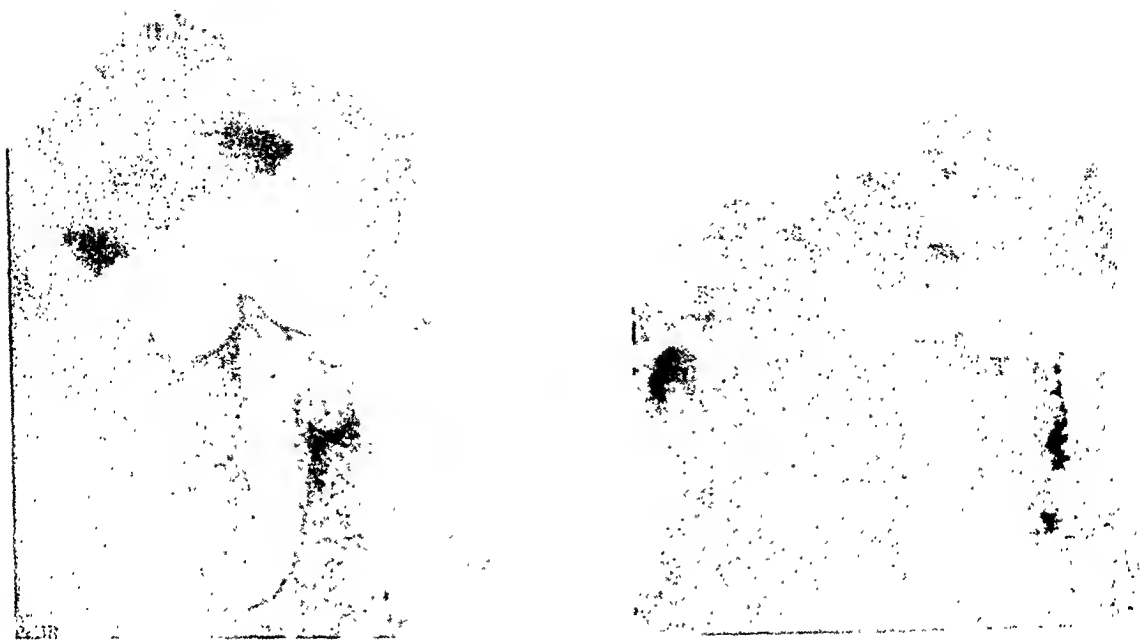


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A Simple Polygraph¹

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WHEN CONSERVATION of x-ray film is a consideration, both industrially and medically, a method, which for lack of a better name we have called a simple polygraph, may be useful, reducing by approximately 50 per cent the amount of film ordinarily used in certain examinations. We have employed the simple polygraph for more than a year and have found it of distinct advantage in the conservation not only of film but also of developing chemicals, film hangers, cassettes, intensifying screens, and time required for producing a certain amount of work. The method has been used in examination of the wrist, mastoids, paranasal sinuses, temporomandibular joints, and the elbow.

The procedure requires only a 10 × 12-inch sheet of lead, 1/32 of an inch in thickness, applied with Casco glue to a masonite backing of the same size in order to make it stable. From one corner a 5 × 6-inch cutout is made (Fig. 1). The device is utilized in non-screen or screen examinations by uniformly rotating it over the film with each additional exposure and position.

In examination of the wrist we have found it essential to obtain routinely more than the usual anteroposterior and lateral views. Therefore, we supplement these with both oblique views (Fig. 2). This practice has proved extremely valuable in cases of carpal injury. Fractures of the carpal navicular are many times more common in the Army than the usual Colles' fracture of civilian life, and the four-view technic is an essential for their diagnosis.

Anteroposterior, lateral, and flexion examinations of the elbow joint are well accommodated by this method (Fig. 3).

Open- and closed-mouth views of the temporomandibular joint are easy to compare on the viewing box, when all are com-

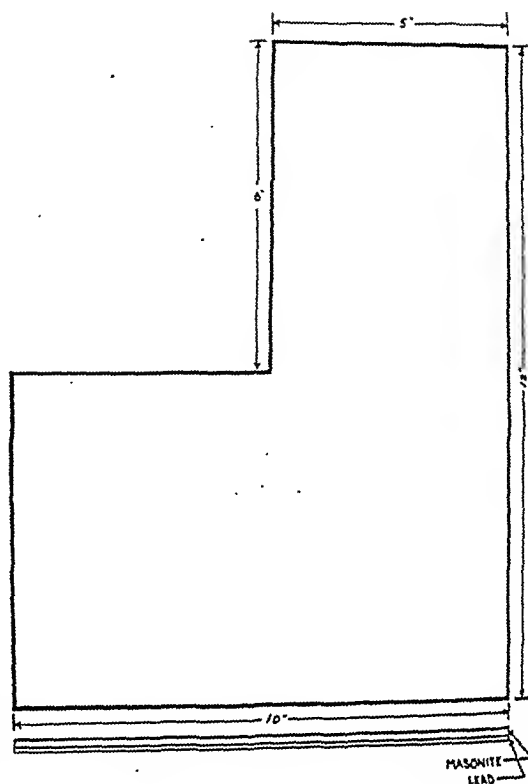


Fig. 1. Diagram of lead sheet used for making simple polygraphs.

bined on the one 10 × 12-inch film (Fig. 6). Mastoid examinations are likewise facilitated with the two views of each mastoid side by side on the same film (Fig. 4).

We feel that four views are usually adequate to demonstrate disease in any or all of the paranasal sinuses. With the simple polygraph method, views in the Caldwell, Waters, and exaggerated Waters positions (the last for visualization of the sphenoid sinuses) and lateral views are no more difficult to obtain than on individual 8 × 10-inch films. The saving of film in this case is obvious, and the ease of examination when multiple views of a single part are combined on a single film (Fig. 5) will be readily appreciated by the busy roentgenologist.

The technical factors involved in obtain-

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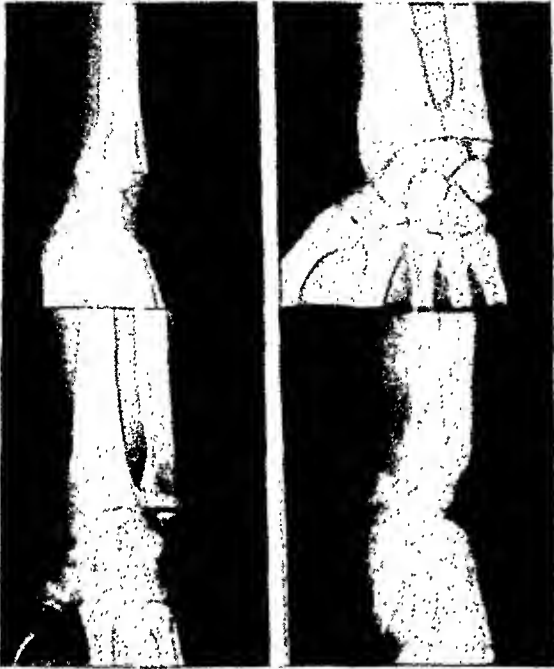


Fig. 2. Simple polygraph of wrist, showing postero-anterior, lateral, and two oblique views.

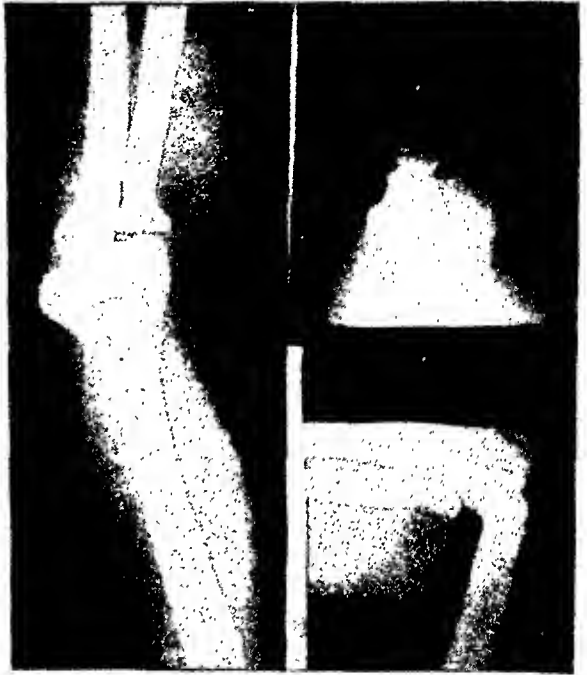


Fig. 3. Simple polygraph of elbow: anteroposterior view and lateral and postero-anterior views in flexion.



Fig. 4. Simple polygraph of mastoids, showing two views of each on a single film.

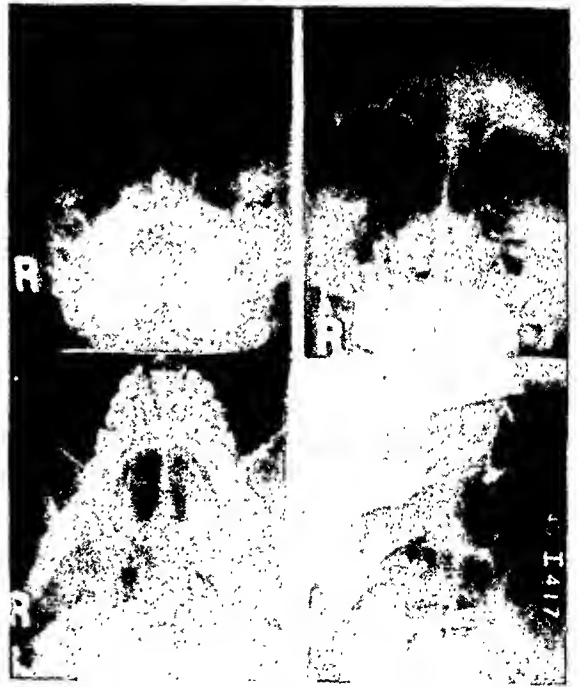


Fig. 5. Simple polygraph of paranasal sinuses, showing four views on a single film.

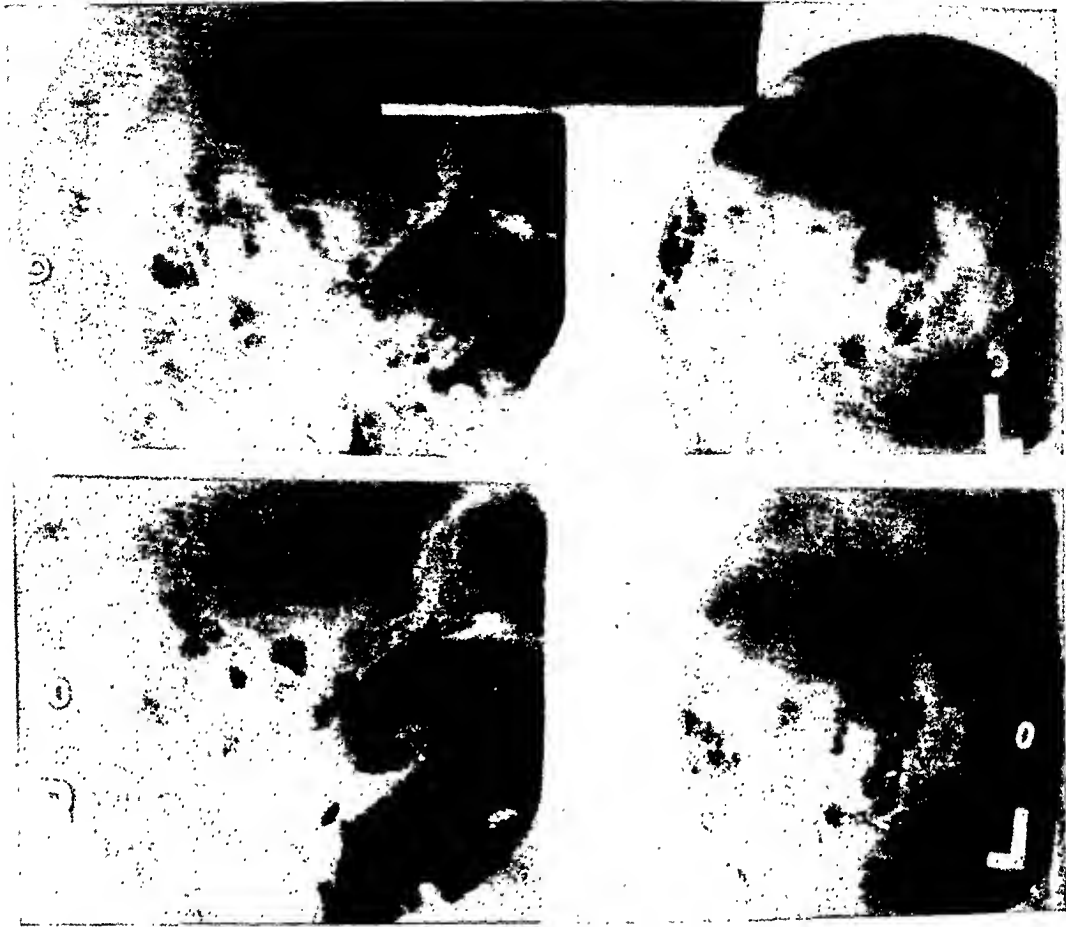


Fig. 6. Simple polygraph of temporomandibular joint.

ing the views reproduced here were as follows:

- Wrist (Fig. 2)
- 36-inch distance
 - 4-inch cylinder cone
 - Non-screen cardboard holder
 - 1.0 mm. Al
- | | | |
|---|----------|-------------|
| Postero-anterior..... | 50 kv.p. | 75 ma. sec. |
| Lateral..... | 60 kv.p. | 75 ma. sec. |
| Postero-anterior and anteroposterior oblique... | 55 kv.p. | 75 ma. sec. |
- Elbow (Fig. 3)
- 36-inch distance
 - 4-inch cylinder cone
 - Non-screen cardboard holder
 - 1.0 mm. Al
- | | | |
|--------------------------------------|----------|-------------|
| Anteroposterior..... | 65 kv.p. | 75 ma. sec. |
| Lateral, 90° flexion..... | 65 kv.p. | 75 ma. sec. |
| Postero-anterior, acute flexion..... | 75 kv.p. | 75 ma. sec. |

Mastoids and temporomandibular joints (Figs. 4 and 6)

- 30-inch distance
- 4-inch cylinder cone
- Parspeed screens
- 1.0 mm. Al

Lateral.....	55 kv.p.	75 ma. sec.
Stenvers position.....	48 kv.p.	75 ma. sec.

Paranasal sinuses (Fig. 5)

- 30-inch distance
- 4-inch cylinder cone
- Parspeed screens
- 1.0 mm. Al

Caldwell position.....	66 kv.p.	45 ma. sec.
Waters position.....	70 kv.p.	45 ma. sec.
Vertico-submental.....	74 kv.p.	45 ma. sec.
Lateral.....	55 kv.p.	30 ma. sec.

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Primary Ewing's Sarcoma of the Spine¹

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PRIMARY EWING'S sarcoma of the spine is sufficiently rare to justify the reporting of an additional case. The roentgenographic changes in that location obviously are not those typical of similar involvement of the long bones. A survey of the pertinent literature reveals 10 cases of primary Ewing's sarcoma of the spine.

In a review of the material in the Bone Sarcoma Registry (1927) and a comprehensive discussion of sarcoma of the bone, Kolodny (1) states that Ewing's sarcoma constitutes 7.5 per cent of bone sarcomas. In his opinion, a Ewing's sarcoma usually affects more than one vertebra, but he believes that this represents multiple primary involvement and not metastatic growth. He reports a series of 650 cases of bone tumor with 40 instances of Ewing's sarcoma and 10 others of more or less doubtful nature. The spine is mentioned as being a favorite site of the tumor, but the incidence of such involvement is not given.

Rix and Geschickter (2) report a series of 291 tumors of the spine, of which 21 were primary malignant neoplasms. They report no cases of Ewing's sarcoma but list 12 cases of sympathicoblastoma and discuss the possibility of it being confused with a Ewing's sarcoma.

Geschickter and Copeland (3) report a series of 125 cases of Ewing's sarcoma and list one instance of primary involvement of the vertebra.

Geschickter and Maseritz (4) discuss the clinical and microscopic similarity of neuroblastoma and Ewing's sarcoma and report a series of 135 cases of the latter tumor. No mention of primary involvement of the spine is made.

Stewart Harrison (5) reports 8 cases of Ewing's bone sarcoma, none of which was primary in the spine.

Lattman (6) published a review on Ewing's sarcoma but did not mention primary occurrence in the spine. He states that primary malignant disease of the bone is rare (1.5 to 2.0 per cent of all malignant neoplasms), with Ewing's sarcoma accounting for approximately 10 per cent of the bone sarcomas.

Brav and Rechtman (7) reported a single case of a Ewing's sarcoma primary in the sacrum, with autopsy findings.

Neeley and Rogers (8) report two cases of primary bone neoplasm of the spine with a histopathological picture consistent with Ewing's sarcoma. These two cases showed no cell type compatible with a diagnosis of sympathicoblastoma.

In a more recent study, Morton (9) reports 6 cases of Ewing's sarcoma of the spine as listed in the Bone Sarcoma Registry (covering the period up to the fall of 1936). A total of 184 cases of Ewing's sarcoma of bone were listed in the Registry for the same period.

CASE REPORT

Clinical History: A white male, aged 21 years, was admitted to the Letterman General Hospital, March 21, 1944, for deep x-ray therapy to the 12th dorsal vertebra and the right 12th rib. The family history was irrelevant and the developmental history was normal.

The patient had been well until September 1943, when he experienced a sudden sharp pain in his right hip. From November 1943 until January 1944, he was hospitalized on several occasions and treated for a subgluteal bursitis. Following his discharge from the hospital on Jan. 9, 1944, he was well until Jan. 15. On the latter date, he was lifting a plank and "felt something snap in the middle of the back." Moderately severe pain developed and persisted, and sometime between Jan. 15 and Jan. 27 a mass appeared at the right costovertebral angle. The patient complained of pain radiating down the anterior aspect of each thigh, and upon further questioning, it was learned that he had noticed some tremors of the lower extremities since October 1943.

The patient was admitted to a station hospital on Jan. 27, 1944, and at that time was also complaining

¹ Accepted for publication in May 1945.

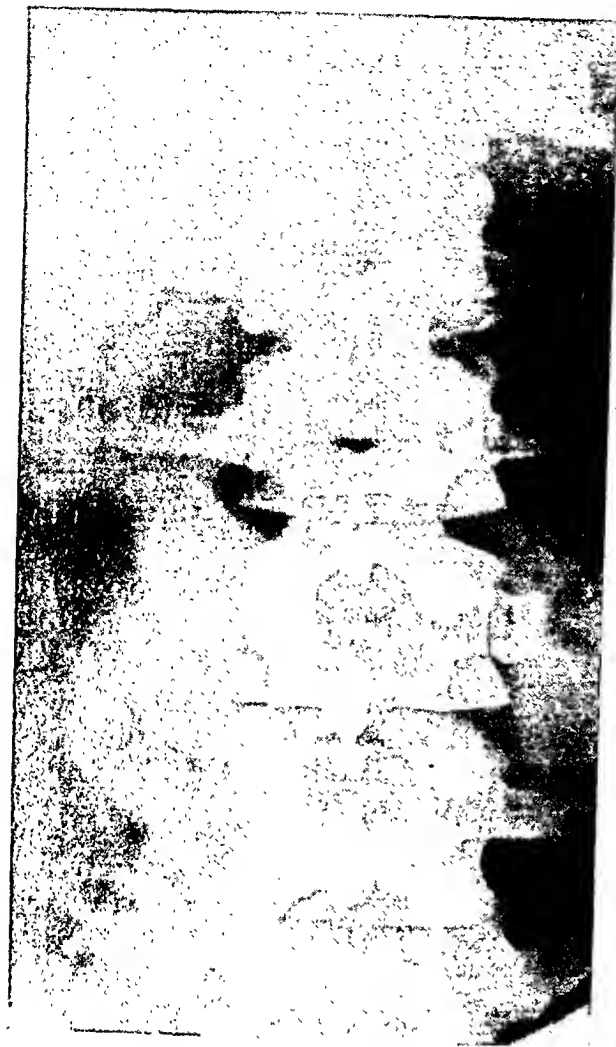


Fig. 1. Original film made Feb. 2, 1944, showing an osteolytic process involving the right half of the 12th thoracic vertebra.

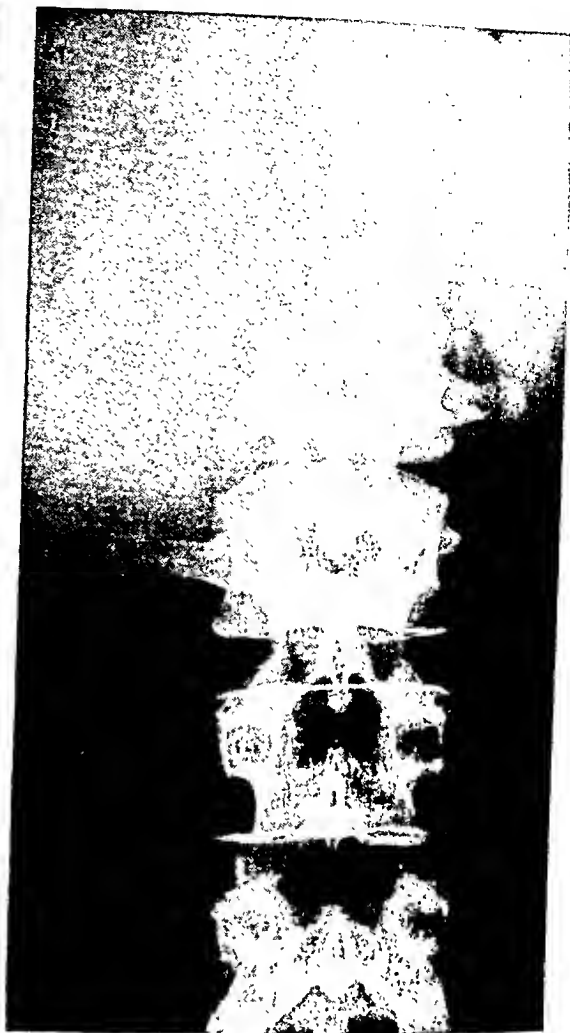


Fig. 2. Rapid increase in the destructive process, as shown by roentgenogram of March 27, 1944. Diagnosis of Ewing's sarcoma established by biopsy.

of urinary frequency and nocturia. X-ray examination of the spine showed an osteolytic process involving the 12th thoracic vertebra and the right 12th rib. He was transferred to a general hospital on Feb. 14, 1944, and tissue removed for microscopic diagnosis disclosed the presence of a Ewing's sarcoma. Before the patient could be transferred for deep x-ray therapy, an upper respiratory infection occurred. A paraplegia rapidly developed and by Feb. 20 was complete. A right hemilaminectomy of the 10th, 11th, and 12th dorsal vertebrae was done Feb. 28, with removal of a large amount of tumor. The patient was transferred to Letterman General Hospital on March 21, 1944.

On admission to Letterman General Hospital, the patient was pale and emaciated, with a complete paralysis of both lower extremities, rectal and bladder incontinence, and loss of all reflexes of both lower extremities. He complained of considerable pain in the region of the 12th thoracic vertebra.

Pathological Report: The small bits of tissue re-

moved for diagnosis were all similar in histologic structure, showing different sized nests of large neoplastic cells, separated by strands of fibrous tissue. There were a few small areas of hemorrhage and at the periphery of the pieces of tissue were occasional bone spicules, some of which were bordered by large osteoclasts. The tumor cells grew in large, solid sheets, without any particular structure. The cytoplasm was clear and the nuclei large and vesicular, with an occasional prominent nucleolus. Frequent bizarre mitotic figures were seen. There were a few blood vessels in the tumor within bands of fibrous tissue. The nuclei of the endothelium of the vessels were swollen and bore a close resemblance to those of the tumor in some instances. *Diagnosis:* Endothelial sarcoma of bone (Ewing's sarcoma).

Operative Findings: The right lamina of the 12th thoracic vertebra was soft and mushy, and the particles of bone were easily removed. The tumor extended laterally to the right and a moderate amount was excised. The right lamina of the 11th

thoracic vertebra was also softened and easily removed. The right lamina of the 10th thoracic vertebra was more normal in consistency and, upon its removal, a thin sheet of tumor was found along the exposed dura.

Irradiation Therapy: The irradiation factors were: 200 kv.; added filtration 0.5 mm. Cu and 1.0 mm. Al; 18 ma.; output 28.5 r/min. measured in air; 50 cm. S.T.D.; h.v.l. 0.9 mm. Cu; area 400 sq. cm. divided into four 10×10 cm. ports. The patient was treated daily with 200 r (in air) to each of two ports for a total of 1,400 r (in air) to each of the four ports. A second series of treatments (same factors and same areas) was begun on May 18 and completed May 26, 1944, with a total of 800 r (in air) to each of the four ports. The total tumor dose is estimated as being 1,800 r.

X-Ray Findings: Films made Feb. 2, 1944 (Fig. 1) show an osteolytic process involving the right half of the 12th thoracic vertebra, with almost complete destruction of the cortex and body of that portion of the vertebra. The right transverse process is absent, probably destroyed. The right 12th rib is partially destroyed and is displaced superiorly. The right pedicle and lamina of the 12th thoracic vertebra are largely destroyed. There is no evidence to suggest new bone formation. No unusual soft-tissue shadows were noted. A complete skeletal survey disclosed no other bone lesions. The lung fields were entirely clear.

Admission films, taken March 27, 1944, at Letterman General Hospital (Fig. 2), show a complete destruction of the entire right half of the 12th thoracic vertebra with the exception of a thin cortical plate on the intervertebral margins. The cortex of the lateral half of the body is completely destroyed. There is no apparent compression of the body of this vertebra nor any apparent narrowing of the interspaces. The right 12th rib is completely destroyed, with the exception of a very small portion of its tip. The residual portion of the tip of this rib is displaced outward and downward from its original position. There is a large soft-tissue tumor occupying this entire area, measuring 10×15 cm. Irregular areas of increased density are scattered throughout the center of the mass and probably represent incompletely destroyed fragments of the 12th rib and 12th thoracic vertebra.

Roentgenograms made April 15, 1944, five and a half weeks after completion of the first course of deep x-ray therapy (Fig. 3), show a marked reduction in the size of the tumor, with dense recalcification of the destroyed portion of the vertebra and the residual mass at the location of the 12th rib. The stature of the body of the 12th thoracic vertebra has been maintained. Repeated chest films continued to show no evidence of metastases.

Clinical Progress: On the third day of x-ray therapy the patient voluntarily stated that he had experienced considerable relief of pain. Pain relief was complete by the fifth day. The tumefaction at



Fig. 3. Dense recalcification five and a half weeks after first course of deep x-ray therapy.

the right costovertebral margin rapidly decreased in size. Within one week the patient was able to distinguish gross differences in temperature over both lower extremities, more marked on the left. There was an associated minimal return of muscular movements, particularly in the gluteal muscles. The next six weeks showed an increase in sensory acuity but only a very slight increase in the muscle movements. Rectal and bladder incontinence persisted.

SUMMARY

A single case of primary Ewing's sarcoma of the spine is described. The initial involvement was in the right half of the 12th thoracic vertebra, with no evidence of spread to the lungs or other bones. The response to irradiation therapy was typical of a Ewing's bone sarcoma. It is not anticipated that this patient will obtain

any more than temporary palliation. Only ten cases of similar involvement of the spine have been reported.

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Enlarged Parietal Foramina and Similar Shadows Seen in Osteoporosis Circumscripta: Two Cases¹

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CASE REPORTS

THE ROENTGENOLOGIC recognition of enlarged parietal foramina is not difficult. While these are not a common finding, radiologists generally are familiar with the appearance of such defects in the upper posterior angle of the parietal bones. A similar picture may, however, be obtained in other diseases of bone, one of which is osteoporosis circumscripta. Of the two cases recorded below, one showed enlarged parietal foramina, with a history

CASE I: S. G. is an American Negro female, 33 years old, married and the mother of a daughter 18 years old. The patient was first seen in the Medical Clinic of Freedmen's Hospital in February 1944 with a multinodular fibroid tumor of the uterus, which was successfully removed. In her case history she called attention to "soft spots" in her skull, present since birth. Other members of her family were said to have similar defects regarded by them as a family secret. Indeed, the patient was admonished by some of her relatives for betraying their



Fig. 1. Case I: Three views of the skull showing enlarged parietal foramina.

suggestive of an inherited character; the other is a case of osteoporosis circumscripta producing defects simulating enlarged parietal foramina.

The typical x-ray findings in the two conditions, with adequate reviews of the literature, are fully covered in articles by Kasabach and Gutman (1) on osteoporosis circumscripta, and by Pepper and Pendergrass (2) on enlarged parietal foramina. The reader is referred to these comprehensive treatises for such additional information as he may desire.

secret and submitting to an x-ray examination of the skull. Large parietal foramina were well seen on the films (Fig. 1).

According to the history similar defects of the skull occurred in the patient's maternal grandmother, a male cousin on the mother's side, and in two sisters, aged 24 and 32 years. A brother, 20 years old, did not have these defects. The patient's daughter had a normal skull. Since most of the members of her family did not live in the District of Columbia, they could not be seen for questioning.

CASE II: O. B., an American Negro female, age 45, unmarried, came to the Surgical Clinic of Freedmen's Hospital in November 1941, complaining of pain along the margins of her upper gums,

¹ From the X-ray Department of Freedmen's Hospital and Howard University College of Medicine, Washington, D. C. Accepted for publication in July 1945.



Fig. 2. Case II: Shadows resembling enlarged parietal foramina in a patient with osteoporosis circumscripta.

radiating backward and of approximately a year's duration. She had been advised to have her upper teeth removed, and this was done six months prior to her visit to our clinic, without relief of pain. The patient was then referred to the x-ray department with the clinical impression of a calculus in a salivary duct, but none was found on roentgen examination.

Routine films of the skull disclosed osteoporosis circumscripta. An unusual finding was rounded symmetrical shadows located at the upper angle of the parietal bone on either side of the cranium. These shadows were sharply defined and resembled enlarged parietal foramina (Figs. 2 and 3). The skull defects were three in number, against two usually seen in enlarged parietal foramina. The location and shape of the shadows, however, fitted the description of enlarged parietal foramina.

Three years later the patient was again examined. Decalcification of the skull had increased, and the rounded shadows originally seen in the region of the parietal foramina were no longer present (Fig. 4.). This is strong evidence against a diagnosis of enlarged parietal foramina. The patient had no knowledge of defects in her skull or of the occurrence of such defects in any members of her family. Her only living relative was a brother, films of whose skull were normal.

CONCLUSION

Two cases showing bilateral rounded defects at the upper angles of the parietal bones are presented. In one of these cases the findings are typical of enlarged parietal



Fig. 3. Case II: Other views of the skull showing shadows similar to those produced by enlarged parietal foramina.

foramina. In the other case, the defects seem to be a part of changes occurring in osteoporosis circumscripta, since they were

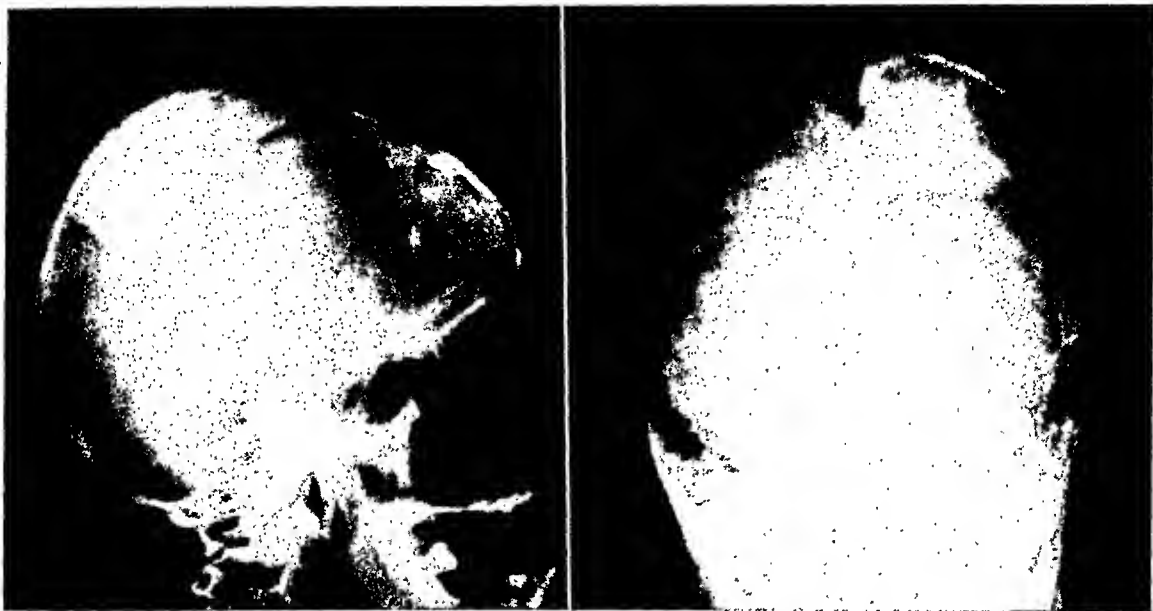


Fig. 4. Case II: Roentgenograms made three years after those reproduced in Figs. 2 and 3, showing increased decalcification of the skull. The rounded shadows in the region of the parietal foramina are no longer demonstrable.

not present in films taken three years after they were first discovered.

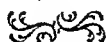
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Skeletal Lesions Associated with Neurofibromatosis

The discovery of an association between lesions involving various systems of the body is always a significant step in the understanding of a disease process. Thus, observations on the skeletal defects associated with the multiple pedunculated tumors and café au lait spots characteristic of von Recklinghausen's neurofibromatosis have gone far toward clarifying the etiology of that condition. That a relationship exists between the superficial tumors and the pathologic process in the bones has become increasingly apparent.

Adrian (1), as early as 1901, called attention to the frequent occurrence of bone lesions in neurofibromatosis, but Stahnke (9) was the first to regard these lesions as part of a systemic involvement. Brooks and Lehman (3) studied the bone changes in the disease and their report, published in 1924, is among the first in the American literature to recognize the osseous lesions as a characteristic manifestation of neurofibromatosis and one which may be of diagnostic significance, more especially in cases in which the so-called "classical" features are not fully developed. They reported seven cases, to which Lehman (6) subsequently added two more. Three types of bony change occurred: scoliosis, abnormalities of bone growth, and "irregularities of outline of the shafts of the long bones, including changes which in the x-ray film appear as subperiosteal cysts."

Though scoliosis was observed in all the cases recorded by Brooks and Lehman, and appears to be almost universally present, they do not consider it characteristic of the disease. In some instances, they believe, it may be due to primary changes in the spine, possibly developmental and pos-

sibly related to the changes in the long bones, while in other cases it may be compensatory for unequal length of the lower extremities. This latter feature was present in three of their patients, being due to excessive growth in two cases, involving the tibia and femur, respectively, and to a shortening of the femur in a third, presumably the result of cystic changes. Spontaneous overgrowth in length of a single long bone these authors believe is to be found in no other condition than von Recklinghausen's disease. It is their opinion that it is usually associated with a congenital elephantiasis. Nørgaard (8) in a more recent paper attributed it to an embryogenic defect.

Localized bone hypertrophy in association with neurofibromatosis was also observed by Moore (7), who reported four cases. The fact that a definite segmental relationship was found to exist between the affected nerve and the overgrowth seemed to him to be the strongest evidence that the neurofibromatosis is responsible for the hypertrophy. The facts as he sees them are as follows: "(1) Localized hypertrophy is often enough associated with neurofibromatosis in a segmental relationship to warrant a belief that there is a causal relationship of the nerve lesion to the hypertrophy. (2) The hypertrophy is not pure overgrowth, but is mixed over- and underdevelopment, and we believe represents uncontrolled growth rather than stimulation of growth. (3) The findings of definite evidence of endarteritis in two of these cases, and hints of it in the other two, may, we believe, have a bearing on the question of the control of normal bone growth."

The third type of bone change noted by Brooks and Lehman varied from slight periosteal and cortical changes to large tumors having the roentgen appearance of bone cysts. These tumors are said to be composed of tissue similar to that found in the skin tumors in association with new formed trabeculae. Their observations, the authors believe, emphasize the fact that neurofibromatosis is a condition affecting osseous structures as well as skin and nerves.

Pseudarthrosis and bowing of the lower leg as a concomitant of neurofibromatosis were reported by Ducroquet (4) in France in 1937, but seem to have escaped notice in the British and American literature until 1939, when Barber (2) recorded five cases of his own and presented in summary the ten cases of his French contemporary. In both series of cases there was definite evidence of a familial tendency. In four of Barber's cases bowing of the leg had been present since birth. Pseudarthrosis followed osteoclasia or osteotomy for correction of the deformity in two cases and fractures in two others. Moore's report, cited above, also included a discussion of pseudarthrosis. Three cases selected from a series of eight were presented. In one case there was histologic proof of neurofibromatosis and in the others the clinical features were unmistakable. In discussing these cases, Moore states that, "since pathological nerves are found in relation to the pathological bone, it seems fair to assume that the two are related." He believes that the tumor of the nerve and the pseudarthrosis stand in the relation of cause and effect, though the mechanism of the production is not entirely clear.

A recent report of a typical case of pseudarthrosis by Green and Rudo (5) adds further proof of the association of neurofibromatosis and pseudarthrosis. In

their patient bone defects were observed previous to fracture. The fracture followed slight trauma and failed to unite until after excision of neurofibromatous tissue at the fracture site. A second fracture went through a similar cycle. The excised material was identical microscopically with the usual picture of neurofibroma. In this case it appeared that the intraosseous neurofibromas developed from nerves within the bone rather than those of the periosteum.

The reports cited above and others furnish cumulative evidence of the existence of bone involvement as well as skin and nerve lesions in neurofibromatosis. Particularly convincing is the evidence that neurofibromatosis is the exciting cause of congenital bowleg and pseudarthrosis. In such cases a careful search should be made for other evidence of the disease, including café au lait spots and tumors of the peripheral nerves and skeletal system.

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RADIOLOGICAL SOCIETIES OF NORTH AMERICA

Editor's Note.—Will secretaries of societies please cooperate by sending information to Howard P. Doub, M.D., Editor, Henry Ford Hospital, Detroit 2, Mich.

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WISCONSIN

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CUBA

Sociedad de Radiología y Fisioterapia de Cuba.—Offices in Hospital Mercedes, Havana. Meets monthly.

ABSTRACTS OF CURRENT LITERATURE

ROENTGEN DIAGNOSIS

The Head and Neck

- SØNDERGAARD, KARL. Passage of Contrast Substances Through the Hypopharynx..... 612
- DANDY, WALTER E. Diagnosis and Treatment of Strictures of the Aqueduct of Sylvius (Causing Hydrocephalus)..... 612

The Chest

- FINE, ARCHIE, AND STEINHAUSEN, T. B. Experiences with the Photoroentgen Method in Chest Surveys: Analysis of 156,000 Examinations..... 612
- SUTHERLAND, CHARLES L., FAWCITT, RICHARD, AND CRAW, JOHN. Discussion on Modern Conceptions of Industrial Lung Disease.... 612
- DILLENBERG, S. M., AND THOMPSON, C. M. Carbon Tetrachloride Poisoning. A Report of Twenty Cases with One Death..... 613
- THOMSEN, GREGERS, AND CHROM, SV. A. A Case Primary Lung Cancer, Presumably Arisen from an Old Tuberculous Cavern..... 613
- DORMER, B. A., FRIEDLANDER, J., WILES, F. J., and SIMSON, F. W. Tumor of the Lung Due to *Cryptococcus histolyticus* (Blastomycosis). 613
- CLART, BYRON M., AND PULLEN, ROSCOE L. Tularemic Pneumonia. Review of American Literature and Report of 15 Additional Cases. 614
- WRIGHT, D. O., AND GOLD, EDWIN M. Loeffler's Syndrome Associated with Creeping Eruption (Cutaneous Helminthiasis)..... 614
- MOEHLIG, ROBERT C. Production of Growth by the Action of the Pituitary Gland on the Vascular and Hemopoietic Systems: Interrelationship Between the Lungs and the Pituitary Gland..... 614
- STEIN, M. H. Spontaneous Mediastinal Emphysema. 615
- ZEMAN, FREDERIC D. Occlusion of the Superior Vena Cava Due to Syphilitic Mediastinitis. Collateral Circulation After Nineteen Years. 615
- FABRICIUS, BRYAN. Value of Kymography for the Differential Diagnosis Between Aneurysm of the Aorta and Mediastinal Tumor..... 615
- BAUER, DONALD DEF. Ebstein Type of Tricuspid Insufficiency: Roentgen Studies in a Case with Sudden Death at the Age of Twenty-Seven..... 615
- GARLAND, LEO H. Myocardial Infarction—Roentgen Diagnosis..... 616
- PARSON, GEORGE W. Dextrocardia with Situs Inversus Complicated by Chronic Rheumatic Aortic and Mitral Endocarditis..... 616
- BJÖRCK, GUNNAR. On the Relationship between the Heart Volume and Various Physical Factors..... 616

The Digestive System

- ADAMS, RALPH, AND HOOVER, WALTER B. Benign Tumors of the Esophagus. Report of Three Cases..... 616
- SØRENSEN, FRANZ. Physiological Delay at the Cardia..... 617
- ARENDT, JULIAN. Chronic Hypertrophic Antrum Gastritis..... 617
- DOHN, KAI, AND FABER, BÖRGE. Invagination of the Stomach: A Case Diagnosed by Means of Roentgen Examination..... 617
- VIDEBÆK, AAGE. Solitary and Multiple Carcinomas of the Upper Alimentary Tract: Their Location, Age and Sex Incidence, and Correlation with Plummer-Vinson Syndrome... 617
- DAILEY, MORRIS E., AND MILLER, EARL R. A Search for Symptomless Gastric Cancer in 500 Apparently Healthy Men of Forty-Five and Over..... 617
- LARSEN, SV. B. Some Cases of Intestinal Tuberculosis in Phthisics, with Reference Especially to the Prognosis..... 618
- ARENDT, JULIAN. Significance of Cannon's Point in the Normal and Abnormal Functions of the Colon..... 618
- NØRGAARD, FLEMMING. Periodic, Spontaneously Remittent Volvulus and the Symptoms in Cases of Colon Elongatum..... 618
- GILBERT, RENÉ-J., AND GARCIA-CALDERÓN, J. Radiologic Study of Cecocolic Invagination in the Adult..... 618
- DRUCKMANN, A., AND SCHORR, S. Roentgenological Manifestations of Amebiasis of the Large Intestine..... 618
- BRANDEL, ENAR. Two Cases of Internal Biliary Fistulae..... 619

The Diaphragm

- KEENE, CLIFFORD H., AND COLEMAN, BENJAMIN. Traumatic Right Diaphragmatic Hernia: Case with Delayed Herniation of the Liver and Gallbladder..... 619
- WAGNER, AAGE. Four Cases of Diaphragmatic Intumescence..... 619

The Musculoskeletal System

- SHELDON, WALTER H., THEBAUT, BEN R., HEYMAN, ALBERT, AND WALL, MARGARET J. Osteomyelitis Caused by Granuloma Inguinale: Report of a Case with Cultivation of the Donovan Body in the Yolk Sac of the Developing Chick Embryo..... 619
- ROSENDAL, THOMAS. On Reticulum Cell Sarcoma in the Bones..... 620
- ANDERSEN, SIGURD R. Malignancy of Giant Cell Tumors: A Study on Giant Cell Tumors and Allied Affections in Bone, with Reference Especially to Their Malignancy..... 620

- ENGELFELDT, BENGT. Cystic Forms of Cancer Metastases in Bone..... 620
- KAUFMAN, JUSTUS. Isolated Myeloma in a Fourteen Year Old Boy..... 620
- JAMES, C. C. MICHAEL. Late Bone Lesions in Caisson Disease. Three Cases in Submarine Personnel..... 621
- DUNGAL, NIELS. Rickets in Iceland..... 621
- MONFORT, JOHN, POLAYES, SILIK H., AND SORKIN, REUBEN. Infantile Dwarfism (Encephalomyelitis) in Siblings..... 621
- ELTORM, HELGE. Case of Cleidocranial Dysostosis..... 621
- FISHER, LLOYD D., PARSONS, CLARE, AND CUTTING, CECIL C. Hereditary Multiple Exostosis. Review of the Literature and Report of Case with Horner-Bernard Syndrome as a Complication..... 622
- BLÖNDAL, INGOLFUR. Case of Cystic Tuberculosis in Bone and Joint..... 622
- MILLMAN, W. S. Osteochondritis Dissecans of the Supratrochlear Septum..... 622
- HERMODSSON, IVAN. Osteochondritis Dissecans of the Head of the Femur..... 622
- CHROM, SV. A. On the Incidence of Osteochondrosis..... 622
- PRESENT, ARTHUR J. Rheumatoid Spondylitis, with Special Reference to Early Diagnostic Criteria..... 622
- OVERGAARD, KRISTIAN. On Bechterew's Disease from the Roentgenologic Point of View. 623
- ERNST, JØRGEN. Duvernay's "Forage" of the Femoral Epiphysis: Follow-Up Examination of 41 Cases..... 623
- NACHLAS, I. WILLIAM, AND OLPP, JOHN L. Pararticular Calcification (Pellegrini-Stieda) in Affections of the Knee..... 623
- HERZOG, E. G. Air Arthrography in Diagnosis of Torn Semilunar Cartilage..... 624
- SELIGMAN, BERNARD, AND NATHANSON, LOUIS. "Metastatic" Calcification in Soft Tissues of Legs in Osteitis Deformans: Case Report... 624
- DANOWSKI, T. S., WINKLER, A. W., AND PETERS, J. P. Tissue Calcification and Renal Failure Produced by Massive Dose Vitamin D Therapy of Arthritis..... 624
- MANN, TREVOR P. Fatigue Fracture of the Tibia. Three Cases at a Naval Training Establishment..... 625
- WOLFE, H. R. I., AND ROBERTSON, J. M. Fatigue Fracture of Femur and Tibia..... 625
- BINGHAM, JOHN A. W. Stress Fracture of Femoral Neck..... 625
- The Genito-Urinary System**
- HUFF, FRANK M., AND HOGER, WILLIAM P., JR. Renal Hypoplasia with Hydroureter and Primary Amenorrhea. Report of a Case..... 625
- LAZARUS, JOSEPH A., AND MARKS, MORRIS S. Primary Carcinoma of Ureter with Special Reference to Hydronephrosis. Review of Literature and Report of an Unusual Case..... 626
- BERTENSEN, ARNE, AND WANDALL, H. H. Vagocervical Vesiculography and Its Clinical Application..... 626
- CHRISTIANSEN, HARALD. Some Practical Hints on the Performance of Urography on Infants. 626
- Technic**
- BACON, JOHN F., AND LEDDY, EUGENE T. Protection in Roentgenoscopy..... 627
- HOLMGREN, BENGT S. Roentgen Cinematography as a Routine Method..... 627
- BOHATYRTSCHUK, F. Results of Micro-Radiography..... 627
- RADIOTHERAPY**
- PROUTY, JAMES V. Treatment of Hemangiomas with Roentgen Rays..... 627
- NORDENTOFT, JENS M. Slowly Developing Non-Pigmented Nevo-Epithelioma Presenting a Non-Characteristic Histologic Picture..... 627
- NIELSEN, JENS. Roentgen Treatment of Malignant Tumors of the Nasopharynx..... 627
- BOUCHARD, JEAN. Skeletal Metastases in Cancer of the Breast: Study of the Character, Incidence and Response to Roentgen Therapy.. 628
- SMITH, GEORGE V. S., AND DRESSER, R. Carcinoma of the Uterine Cervix: Interval Report on Treatment, Results and Complications.. 628
- PEAKE, JOHN D. Radiation Therapy in Uterine Fibroids..... 629
- HOSTER, HERMAN A., AND DOAN, CHARLES A. Studies in Hodgkin's Syndrome. IV. Therapeutic Use of Radioactive Phosphorus. 629
- THYGESEN, JØRGEN E., VIDEBAEK, AAGE, AND VILLAUME, IRGENS. Treatment of Leukemia with Artificial Radio-active Sodium: Preliminary Report..... 630
- Dosage**
- JENSEN, ANTON. Dosis Measurements in Roentgen Irradiation of Female Pelvis..... 630
- NIELSEN, HOWARD. Determination of the Dose in Circular Phantoms Under Rotatory Irradiation..... 630
- JENSEN, SV. HOEFFER. A Simple Device for the Continuous Control of Roentgen-Ray Output. 630

ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Passage of Contrast Substances Through the Hypopharynx. Karl Söndergaard. *Acta radiol.* 26: 222-224, Jan. 22, 1945. (In English.)

In order to establish a norm for deglutition, a study of swallowing of thick and thin media was undertaken. In no normal subject was there any retention of liquid medium in the valliculae, but with thick media retention up to thirty minutes was observed. In the presence of paralysis, retention was also observed, but it can be considered significant only when it lasts more than thirty minutes; other signs are of greater diagnostic importance.

LEWIS G. JACOBS, M.D.

Diagnosis and Treatment of Strictures of the Aqueduct of Sylvius (Causing Hydrocephalus). Walter E. Dandy. *Arch Surg.* 51: 1-14, July-August 1945.

Strictures of the aqueduct of Sylvius (the iter) are congenital maldevelopments characterized by replacement of the channel by glial tissue, resulting in internal hydrocephalus. In infants the diagnosis is simple and fairly reliable; if the phenolsulfonphthalein test shows obstruction in the ventricular system and the inion (external occipital protuberance) is low, the obstruction is at the aqueduct. If the inion is high, the obstruction will be at the foramina of Magendie and Luschka. The altered position of the inion is due in the latter case to enlargement of the contents of the posterior fossa, and in the former to depression of the tentorium.

Strictures of the aqueduct in older children and adults produce few localizing signs, and ventriculography may be required for differentiation from tumors without signs of localization. Filling of the aqueduct and anterior part of the fourth ventricle excludes a stricture, but air shadows showing obstruction in the aqueduct may be due either to stricture or tumor. In such cases cerebellar exploration has usually been done. It is now possible, however, in most cases to reach a correct diagnosis by a study of the shape of the air shadow as disclosed by ventriculography, provided filling of the ventricular system ahead of the obstruction is complete. A triangular or funnel-shaped shadow is typical of stricture. Occasionally an obstruction due to a diaphragm may lead to confusion, but this is rare. Even ventriculography may be unnecessary and a diagnosis may be established on the basis of the height of the inion, determined preferably by roentgen examination. As suggested above, with a posterior fossa tumor the inion will usually be higher than normal. If, however, the head is oversize, the sutures are separated, and there is evident hydrocephalus, *without* elevation of the inion, a diagnosis of stricture of the aqueduct is highly probable. The author was able to make a diagnosis on this basis in 5 cases.

Treatment is by third ventriculostomy, through a lateral approach. In patients over one year of age good results can almost always be secured, although sometimes reoperation may be necessary. In the author's series of 29 patients in this age group, 24 were living and well, 4 of these with some degree of mental retardation. In patients under one year the chance of a good result is much less, a possible reason being the failure of the subarachnoid spaces to reopen after release of the pressure. Of 63 patients in this age group who were operated

upon, 21 were known to be still alive. The hydrocephalus was cured in 12, but only 5 of these had a normal or nearly normal mentality. For this reason, operation is considered inadvisable in infants with a head circumference over 50 to 52 cm.

LEWIS G. JACOBS, M.D.

THE CHEST

Experiences with the Photoroentgen Method in Chest Surveys: Analysis of 156,000 Examinations. Archie Fine and T. B. Steinhausen. *Ohio State M. J.* 41: 709-710, August 1945.

The authors have reviewed 156,000 examinations of prospective aviation cadets. Examinations were made by the photoroentgen method, with 4 × 5-inch films, and suspicious lesions were restudied on 14 × 17-inch films. The smaller films were of excellent quality, and the authors feel that for screening purposes a pair of stereoscopic 4 × 5-inch films is as satisfactory as a single 14 × 17-inch film. [With this conclusion all will not be in agreement. One frequently hears the opinion expressed that in the reading of chest films, the single 14 × 17-inch film often brings to the eye lesions not so quickly or readily seen when peering into the stereoscope, the stereoscopic films being favored for additional approach to certain lesions previously discovered.] The incidence of tuberculous and non-tuberculous lesions in the group examined is given in tabular form.

PERCY DELANO, M.D.

Discussion on Modern Conceptions of Industrial Lung Disease. Charles L. Sutherland, Richard Fawcitt, and John Crow. *Proc. Roy. Soc. Med.* 38: 519-534, July 1945.

Sutherland opens this discussion of pneumoconiosis, quoting from the Annual Report (for 1943) of the Senior Medical Inspector of Factories: "... Admittedly, with the exception of silicosis and asbestosis, we are only touching on the fringes of the pneumoconioses. . . . Exposure to an industrial dust . . . does not necessarily imply the existence of a pneumoconiosis, or disease, or present or future disablement, any more than the discovery of asbestosis bodies in the sputum by itself determines anything but exposure to asbestos dust, and that, not necessarily to a significant degree."

A distinction is made between pulmonary fibrosis due solely to free silica, which is sometimes given the name of "classical silicosis," and the changes produced by mixed dusts. The characteristic lesion of classical silicosis is the so-called siliceous nodule, composed of whorled collagenous tissue, containing some dust in its interstices but more aggregated on its periphery. These nodules are scattered unevenly throughout the lungs, producing the familiar "snowstorm effect" in the film. Between the nodules there may be some haziness, but no striations are ordinarily discernible. Actually the nodule represents to some extent a final result, inasmuch as it marks the encapsulation of the noxious silica dust, though radiologically nodulation is the first pathognomonic evidence of the disease. The South African Miners' Phthisis Medical Bureau recognizes "well marked linear striation" and "increased arborization" as radiologic evidence of a prenodular

stage, but these findings are not usually accepted in England and America.

Sutherland considers every case of silicosis as potentially tuberculous and stresses the importance of study of all films for signs of infection.

Coal miners are exposed to a variety of dusts. Three types of lung changes are recognized: reticulation, nodulation, and massive fibrosis. Silica probably plays a large part in the production of these lesions, although its action is modified by other dusts. Massive fibrosis has been variously ascribed to: (1) blocking of the lymphatics; (2) coalescence of nodules; and (3) infection. A fourth factor may be irritation.

Asbestosis is not produced in the same way as silicosis, for finely ground asbestos dust has been shown experimentally to have no irritative effect. Owing to the size and shape of the particles, there is damage to the bronchi, leading to dilatation; the pleura is thickened and adherent at its base, and there is also an interstitial fibrosis accompanied by emphysema. Definite x-ray changes are described as a ground-glass appearance of the lung parenchyma with a fine stippling.

Fawcitt emphasizes, as does Sutherland, the importance of co-operation between the radiologist and clinician and an exhaustive occupational history for the diagnosis of pneumoconiosis. He stresses, also, the necessity of careful radiographic technic, since "the x-ray picture of reticulation may be produced in the normal way by change in technique." He also contrasts the effects of organic and inorganic dusts. A series of illustrations is presented showing pneumoconiosis in hematite iron ore workers, illustrating individual variations in the process and some of the pitfalls in differential diagnosis. Hematite ore dust is of the radiopaque type and may be demonstrated in the lungs after a brief period of employment, though disease is not necessarily present.

Craw devotes his part in the discussion to a correlation between the radiologic findings in hematite ore workers and the pathological anatomy. He makes the point that the dense radiological shadows are due to the simple accumulation of particulate hematite, and that there is no stimulation of collagenous fibrosis and practically no increase in reticulin fibers. He concludes, also, that nodulation without massive fibrosis is a rare condition; that large-sized classical nodulation occurs only in the presence of established tuberculosis and is always associated with solid fibrotic masses; that the fibrotic response in the lungs bears no relationship to the total amount of silica or hematite present.

PERCY J. DELANO, M.D.

Carbon Tetrachloride Poisoning. A Report of Twenty Cases with One Death. S. M. Dillenberg and C. M. Thompson. *Mil. Surgeon* 97: 39-44, July 1945.

Twenty cases of carbon tetrachloride poisoning are reported. Two men worked with this solvent in a confined compartment on a submarine, without adequate ventilation; the others inhaled the fumes while in or near the compartment over a period of two days. The initial symptoms in all 20 cases were headache, malaise, hiccups, anorexia, nausea, and vomiting. Nine patients with gastro-intestinal symptoms only were treated aboard the submarine tender and recovered without complications in four days. Albuminuria was present in 11 cases and these patients were admitted to the dispensary. Seven men recovered in a week

without untoward sequelae; the others were critically ill, and one died. These cases are described in detail.

The 4 severely ill patients presented a typical toxic nephrotic syndrome, with puffiness and swelling of the soft tissues of the face, hands, and feet. Two patients exhibited the waxy pallor and facies of nephrosis. All 4 patients had retention of nitrogenous waste products in the blood stream. Despite the signs of kidney damage, no red blood cells were found in the urine. In contradistinction to cases of carbon tetrachloride poisoning recorded in the literature, no clinical evidence of liver damage was shown by these patients. In no case was the liver palpable or tender at any time, and none of the patients was jaundiced. One of the most prominent physical findings was severe flame-like subconjunctival hemorrhages which slowly disappeared over a period of four weeks.

Chest x-ray findings in the 4 serious cases varied from a mild prominence of all lung markings in one patient to complete consolidation of all five lobes in a man in whom acute pulmonary edema developed after apparent improvement. This complication occurred nine days after exposure, and the patient died despite all treatment. Roentgenograms are reproduced.

A Case of Primary Lung Cancer, Presumably Arisen from an Old Tuberculous Cavern. Gregers Thomsen and Sv. A. Chrom. *Acta radiol.* 26: 230-238, Jan. 22, 1945. (In English.)

A case report of a "squamoepithelial" carcinoma of the right upper lobe of the lung which probably arose in an old tuberculous cavity. The correct diagnosis was not made until necropsy, due to the confusing mixture of signs of tuberculosis and tumor. The possible role of tuberculosis in the development of cancer is discussed, and various writers are quoted.

LEWIS G. JACOBS, M.D.

Tumor of the Lung Due to *Cryptococcus histolyticus* (Blastomycosis). B. A. Dormer, J. Friedlander, F. J. Wiles, and F. W. Simson. *J. Thoracic Surg.* 14: 322-329, August 1945.

Certain yeast-like fungi, the blastomyces, may produce local lesions involving skin and bones or may become generalized, producing lesions of the internal organs, most commonly the lungs. Among the organisms causing blastomycosis is the so-called *Cryptococcus*. *Cryptococcus capsulatus* (Darling) produces the fatal histoplasmosis. *Cryptococcus histolyticus* is the cause of a not uncommon form of meningitis. No previous report of pulmonary tumor due to the blastomyces could be found.

The authors' patient was a 12-year-old boy who had a large, well defined mass in the right mid-lung field, demonstrable roentgenographically. It was removed surgically and found to be hard, fibrous, and slightly lobulated. It was easily enucleated from the lung and weighed 1 1/2 pounds. Microscopically the picture was that of a granuloma with *Cryptococcus histolyticus* found readily in the tissue. A meningitis developed postoperatively which did not respond to ordinary drugs but cleared up with potassium iodide. The spinal fluid was injected into the lung of a guinea-pig, which died on the fifty-second day. The guinea-pig's lung showed a chronic interstitial pneumonitis and multiple yeast-like bodies morphologically identical with *Cryptococcus histolyticus*. HAROLD O. PETERSON, M.D.

Tularemia Pneumonia. Review of American Literature and Report of 15 Additional Cases. Byron M. Stuart and Roscoe L. Pullen. *Am. J. M. Sc.* 210: 223-236, August 1945.

Twenty-one cases of tularemia pneumonia (6 previously reported) are summarized, bringing the total number recorded in the American literature to 268. In 115 of these a definite history of contact with animals was obtained, rabbits being implicated in 92. In 171 cases the tularemia was of the ulceroglandular, oculoglandular, or glandular type, and in 97 of the typhoidal type. Reports from various sources indicate that pneumonia is more common in the typhoidal type. Pulmonary involvement has been attributed by some to hematogenous dissemination and by others to inhalation of the organisms.

The 95 autopsy reports in the literature on patients dying with tularemia showed lesions of tularemia pneumonia in 69, an incidence of 72.6 per cent in fatal cases. The most frequent pulmonary involvement in these cases was a lobular or a confluent lobular pneumonia affecting one or more lobes. The nodules may show caseous necrosis, and actual cavities have been observed. An accompanying pleural reaction occurs in about half the cases of tularemia pneumonia.

In tularemia of the ulceroglandular, oculoglandular, or glandular type the pneumonic symptoms may follow from one or two days to many months after the development of the localized infection. In the typhoidal cases the infection appears to originate as a primary pneumonia. In general, pulmonary symptoms are less severe than those associated with other primary forms of pneumonia. The fever curve is spiking in character, while the pulse rate is relatively slow. The physical findings are usually those of an atypical pneumonia. Even though the pleuropulmonary involvement is demonstrable roentgenographically, the physical examination in some patients may reveal nothing of significance.

The most consistent roentgenographic features are enlarged and nodular hilar shadows usually occurring early in the disease. Bihss and Berland (*Radiology* 41: 431, 1943) thought that the non-typhoidal cases usually showed hilar adenopathy with subsequent involvement of the lung parenchyma or the pleura, while in the typhoidal cases parenchymal involvement might not be preceded by hilar adenopathy. Abscess cavities are demonstrated occasionally.

In typical cases of tularemia the diagnosis may be made from careful clinical and roentgenologic investigation. Only the demonstration of *B. tularensis* in the upper respiratory tract, however, establishes the tularemia nature of the pulmonary lesions. In the absence of an occupational history, ulceration, and lymph node involvement, the diagnosis of tularemia rests upon the laboratory findings, especially agglutination tests, though these cannot be relied upon until after the second week of the disease, and in fulminating infections a positive test may be delayed or may never be present. Material secured by lung puncture or from secretions or autopsy material may be inoculated into small animals with consistently reliable results.

Tularemia pneumonia may be mild and transient, and, except for roentgenography, may go unrecognized. On the other hand, pulmonary involvement may contribute largely to the death of the patient. Pneumonia, like tularemia peritonitis or pericarditis, is of grave prognostic significance, especially if bilateral. The pneumonia may last from a few days to several weeks. When

the duration is longer than three weeks, a complication such as an abscess, secondary infection, or fibrosis should be suspected.

Unless there is evidence of secondary infection, the treatment is largely supportive or symptomatic.

BENJAMIN COLEMAN, M.D.

Loeffler's Syndrome Associated with Creeping Eruption (Cutaneous Helminthiasis). D. O. Wright and Edwin M. Gold. *J.A.M.A.*, 128: 1082-1083, Aug. 11, 1945.

Loeffler's syndrome consists of the triad of transient and migratory pulmonary infiltration, paucity of symptoms and physical signs, and peripheral eosinophilia. It is thought to be an allergic phenomenon and has been reported associated with tuberculosis, *Ascaris* infection, trichinosis, asthma, Malta fever, *Endameba histolytica* infection, and pollinosis. Wright and Gold state that cutaneous helminthiasis represents an additional etiologic factor. This opinion is based upon observations of nine patients in whom roentgenologically visible transient pulmonary infiltration developed during the course of the nematodal skin infection.

JOHN F. HOLT, M.D.
(University of Michigan)

Production of Growth by the Action of the Pituitary Gland on the Vascular and Hemopoietic Systems: Interrelationship Between the Lungs and the Pituitary Gland. Robert C. Moehlig. *Am. J. Roentgenol.* 54: 109-127, August 1945.

Evidence is presented to support the view that the pituitary gland produces growth by the formation of blood vessels and by supplying blood to the tissues; that there is a reciprocal relationship between the lungs with their vital functions of oxygenation and respiratory water metabolism and the pituitary gland. Some of the points made by the author are as follows:

(1) The production of localized gigantism has been seen in association with arteriovenous fistula of an extremity, showing that it is by an increase in the vascular development with consequent increase in blood supply that growth takes place. Assuming that the pituitary gland induces growth by developing the circulatory system of the body and hemopoiesis, there is no need to assume the presence of specific hormones or polyhormones since all endocrine glands would be affected by this mechanism as well as the body as a whole.

(2) Congenital hypopituitarism results in a defective development of the vascular system with a decrease in blood supply to the tissues, resulting in dwarfism. The dwarfism of cretinism and other forms of dwarfism as well can be explained on this same basis.

(3) The eosinophilic cells of the pituitary probably are responsible for vascular development, while the basophilic cells are responsible for hemopoiesis.

(4) Primary diseases of the lungs, such as cancer, chronic pulmonary suppuration, and chronic pulmonary osteoarthropathy, are often associated with pituitary chromophil hyperplasia. It is suggested that the lung disease produces an inflammatory reaction which calls for vascularization, oxygenation, and hemopoiesis, and this in turn results in a compensatory hyperplasia of the pituitary chromophil cells.

(5) A close relationship has been shown between the posterior pituitary lobe and the vascular system by pharmacologic effects.

L. W. PAUL, M.D.

Spontaneous Mediastinal Emphysema. M. H. Stein. *New York State J. Med.* 45: 1659-1662, Aug. 1, 1945.

The symptoms produced by spontaneous mediastinal emphysema may closely simulate those of coronary occlusion, pericarditis, pulmonary embolism, and dissecting aneurysm of the aorta. The differential diagnosis, therefore, is of importance. The usual predisposing causes are trauma to the chest, unusual pulmonary effort, such procedures as induction of pneumothorax, pneumoperitoneum, tracheotomy, bronchoscopy and neck dissections, and infections such as tuberculosis, pneumonia, diphtheria, and influenza. Most cases occur in young adult males.

The rupture of pulmonary alveoli allows air to escape into the surrounding pulmonary tissue, whence it follows fascial planes to the hilus of the lung and into the mediastinum. There it infiltrates the tissues between the heart and anterior chest wall, producing severe pain, often simulating angina particularly since the radiation is identical. The pain may be aggravated by deep breathing, turning the head or body, or by swallowing. If the air continues to arrive in the mediastinum and is trapped there, cardiac compression may produce serious complicating effects. Fortunately this does not occur often, as the ruptured alveolus is usually sealed off fairly promptly and in most cases the air is absorbed over a period of several days. In some there is a concomitant spontaneous pneumothorax which is almost invariably over the left upper lobe. This tends to compress the lung and often produces a self-limiting effect on the emphysema. The air in the mediastinum may leak into the neck, chest wall, shoulders and arms, producing subcutaneous emphysema there. It may descend through the diaphragm into the retroperitoneal space and may even go into the abdominal wall and down over the lower extremities.

The most significant diagnostic finding is a peculiar sound heard over the left border of the sternum on systole, variously described as a crunching, bubbling, crackling, crepitant, or clicking sound. It is heard best with the patient holding his breath at the end of expiration. Cardiac dullness is partially or completely obliterated. Usually no significant constitutional symptoms are present. The electrocardiogram is usually normal. Other laboratory tests are commonly negative.

X-ray studies of the chest may show a collection of air in the anterior mediastinum between the heart and chest wall on the lateral view or parallel to the heart border in the anteroposterior view, but a negative x-ray picture does not invalidate the diagnosis. The associated pneumothorax will be apparent when present. [The author does not note that air in the neck, chest wall, and shoulders should be easily recognizable radiographically.]

In most cases, the prognosis is good, as the air is gradually absorbed without surgical intervention. In severe cases, with compression of the heart and great vessels, aspiration of the trapped air may be needed.

Two cases of spontaneous mediastinal emphysema are reported. BERNARD S. KALAYJIAN, M.D.

Occlusion of the Superior Vena Cava Due to Syphilitic Mediastinitis. Collateral Circulation After Nineteen Years. Frederic D. Zeman. *J. Thoracic Surg.* 14: 330-338, August 1945.

A case of occlusion of the superior vena cava attributable to syphilitic mediastinitis with secondary venous

thrombosis is recorded. The patient was first seen in 1926, at the age of 49, with a typical picture of superior vena cava obstruction of six months' duration, clinical and laboratory evidence of syphilis, and a history of chancre as a young man. He was actively treated for syphilis and showed some clinical improvement. Eighteen years later (November 1943) he again presented himself, complaining of precordial pain and dyspnea on exertion, which are attributed to hypertensive cardiovascular disease. He now had large varicose veins over the thorax, but the only symptoms referable to the vena cava obstruction were a sense of fullness and throbbing of the head on bending over. The venous pressure in the arms was elevated and could be made to rise by constricting the thorax; circulation time from the arms was delayed. The patient was still alive at the time of the report and seemed well adjusted to the obstruction in the superior vena cava.

The roentgenograms as reproduced do not show very clearly the changes described. Diodrast was injected in the cubital veins of both arms, and following this the collateral circulation on the chest wall was fairly well demonstrated. The obstruction in the vena cava is not satisfactorily shown. An obstruction in the left subclavian vein is seen quite clearly.

From a review of the literature it is evident that obstruction of the superior vena cava is unusual, and thrombosis of that vessel is an even greater rarity. In the reported cases syphilis was a common cause of both thrombosis and external constriction of the large veins.

From a clinical point of view the presence of transitory edema of the head and neck observable on rising in the morning and disappearing slowly in the upright position is pathognomonic of venous obstruction in the upper mediastinum. HAROLD O. PETERSON, M.D.

Value of Kymography for the Differential Diagnosis Between Aneurysm of the Aorta and Mediastinal Tumor. Bryan Fabricius. *Acta radiol.* 26: 89-98, Jan. 22, 1945. (In English.)

The author studied 29 cases of aortic aneurysm and 11 of mediastinal tumors kymographically to determine the accuracy with which the two conditions could be distinguished. He concludes that it is not possible in all instances to make this distinction, as some aneurysms fail to show linear rarefactions and characteristic pulsation, while these features may be present in tumors which are highly vascular and in intimate connection with the aorta. LEWIS G. JACOBS, M.D.

Ebstein Type of Tricuspid Insufficiency: Roentgen Studies in a Case with Sudden Death at the Age of Twenty-Seven. Donald deF. Bauer. *Am. J. Roentgenol.* 54: 136-144, August 1945.

Ebstein's disease of the heart is a rare congenital malformation consisting essentially of downward displacement of the tricuspid valve in an otherwise completely developed heart. The right auricle is greatly enlarged and the foramen ovale is usually patent. The true right auriculoventricular ostium is enlarged. A case is presented in detail, the seventeenth in the literature and the fourth in which sudden death occurred. The patient was 27 years old at the time of death. The roentgen evidences of tricuspid insufficiency were: massive enlargement of the cardiac shadow to the right and left in the absence of pulmonary congestion and in the presence of vigorous pulsations; a prominent upper medias-

tinal shadow with widened superior vena cava; enlargement of the right atrium and ventricle and actual difficulty in visualizing the small left ventricle.

L. W. PAUL, M.D.

Myocardial Infarction—Roentgen Diagnosis. Leo H. Garland. U. S. Nav. M. Bull. 45: 89-96, July 1945.

In most instances the clinical diagnosis of myocardial infarction is reasonably reliable. However, in cases in which the history or electrocardiographic findings are inconclusive or not in agreement, additional data are desirable. In these cases fluoroscopy, roentgenography, and roentgenkymography may be useful.

Fluoroscopic detection of myocardial damage is dependent on localized abnormalities of curvature or motion of the cardiac silhouette. Flattening and diminished excursion of the ventricular wall are the most common findings. Bulging and paradoxical pulsation are less frequently seen. Roentgenograms are useful for determination of heart size and shape.

The technic of and indications for roentgenkymography are discussed. Positive kymographic findings in myocardial infarction include (1) localized diminution or absence of pulsation, (2) systolic expansion or paradoxical pulsation, and (3) partial systolic expansion or marked diastolic irregularities. Negative findings do not exclude the possibility of infarction but appear to occur in less than 30 per cent of cases. The degree of kymographic abnormality usually parallels the extent or severity of infarction.

A case is reported in which myocardial infarction was correctly diagnosed on the basis of kymographic findings, in spite of negative electrocardiographic and inconclusive clinical evidence. The diagnosis was verified at autopsy.

H. H. WRIGHT, M.D.

Dextrocardia with Situs Inversus Complicated by Chronic Rheumatic Aortic and Mitral Endocarditis. George W. Parson. Ann. Int. Med. 23: 102-107, July 1945

Dextrocardia complicated by acquired organic heart disease must be rare, for Abbott and Russek (Am. J. M. Sc. 204: 516, 1942), reporting a case with calcareous aortic stenosis, listed only five previous case reports. In these, the acquired lesions were mitral stenosis, hypertensive heart disease, coronary thrombosis, hypertensive and coronary heart disease, and syphilitic aortitis and aortic insufficiency. Apparently no instance of dextrocardia complicated by combined aortic and mitral endocarditis has been previously recorded.

The author's patient was a 24-year-old white woman, in whom dextrocardia had been recognized at the age of one month. Her infancy, childhood, and early adult life had been normal; she had married at the age of 18 and had two children, 3 1/2 years and 14 months old. There was a history of an acute febrile illness at the age of 21, with red, swollen, painful joints. During the patient's second pregnancy a cardiac lesion was recognized, but apparently no myocardial failure developed. Dyspnea and edema occurring post partum responded to digitalis and diuretics. The chief complaints on admission were pain in the right side of the chest and "throbbing of the heart."

The patient appeared weak and chronically ill. Blood pressure was 95 to 105 mm. Hg systolic and 50 mm. diastolic. The temperature was not elevated. The heart rate was 110 per minute. The cardiac apex

impulse was visible and palpable well outside the mid-clavicular line, 11 cm. to the right of the mid-sternal line. On auscultation a loud harsh systolic aortic murmur and a distinct diastolic aortic murmur were present. The first mitral sound was loud and crescendo.

Fluoroscopic and roentgenographic examination revealed a transposition of the heart, moderate cardiac enlargement, a small right-sided aortic knob, enlargement of the conus of the right ventricle, increased markings in the lung fields, and enlarged hilar shadows. The left leaf of the diaphragm was higher than the right. In the left oblique view the significant finding was a dorsal displacement of the barium-filled esophagus by an enlarged left auricle. A transposition of the stomach and colon was demonstrated by fluoroscopic and roentgenographic examination following a barium meal.

The diagnosis of endocarditis was based on the history of the acute febrile illness resembling rheumatic fever and the physical findings. A pronounced systolic basal thrill and a loud, well transmitted systolic and a distinct diastolic aortic murmur in a young person are indicative of chronic rheumatic aortic endocarditis. The fluoroscopic and roentgenographic findings of enlargement of the conus area of the right ventricle and of enlargement of the left auricle are the usual structural changes demonstrable in mitral stenosis. The broad, notched P-waves in Leads I and II of the electrocardiogram were evidence of left auricular strain, and inverted T-wave changes in Leads II and III suggested right ventricular strain. Both of these are produced by mitral stenosis.

STEPHEN N. TAGER, M.D.

On the Relationship between the Heart Volume and Various Physical Factors. Gunnar Björck. Acta radiol. 25: 372-378, Sept. 20, 1944. (In English.)

Among the different correlation factors for the evaluation of the heart volume, body height, body weight, body surface, and basal metabolism are most frequently considered. Minor factors are blood volume, general muscular development, and volume of the heart muscle proper. In a study of 136 persons ranging in age from thirteen to seventy years without serious general disease or circulatory disturbances, body height was found to be unsuitable as a correlation factor for the estimation of the relative heart volume. The question whether body weight or body surface is preferable as a correlation factor was not conclusively answered by the observations, the difference between the results obtained by the two methods being insignificant. The dependence of the heart volume on the body metabolism appeared not entirely reliable when the metabolism was calculated by means of oxygen consumption. The relationship between body weight and heart volume was found to be especially misleading in cases of marked obesity. In such persons the correlation of heart volume to body surface appears to be more acceptable.

ERNST A. SCHMIDT, M.D.

THE DIGESTIVE SYSTEM

Benign Tumors of the Esophagus. Report of Three Cases. Ralph Adams and Walter B. Hoover. J. Thoracic Surg. 14: 279-286, August 1945.

Benign esophageal tumors are rare, a complete review of the literature revealing only 94 cases. The authors

add 3 more cases and tabulate the collected series as to microscopic diagnosis. Polyps formed the largest group, 35 cases. The next largest group was made up of the myomas and leiomyomas, 16 cases. There were 8 fibromas, 9 papillomas, 6 lipomas and lipomyomas, and 6 cysts. Other tumors of less frequent occurrence included aberrant thyroid, adenoma, hemaangioma, myxofibroma, neurofibroma, osteochondroma, and giant-cell tumor.

Roentgenograms illustrate the three case reports, but with one exception the reproductions are unsatisfactory. The surgical problems involved in the three cases are discussed in detail. The cases were handled differently, but good results followed operation in each instance.

The roentgen diagnosis of these tumors does not seem to present any particular difficulty, with the exception of intramural extramucosal lesions, where it might be difficult to decide whether the mass were entirely extrinsic to the esophageal wall. Barium will flow evenly around the intraluminal tumors, producing a picture in strong contrast to the narrow irregular channel of a carcinoma.

HAROLD O. PETERSON, M.D.

Physiological Delay at the Cardia. Franz Sørensen. *Acta radiol.* 26: 225-229, Jan. 22, 1945. (In German.)

Eighty-five patients with no symptoms referable to the esophagus were examined after ingestion of a contrast meal to determine the normal opening time of the cardiac sphincter. In 63 no delay at all was observed at the cardia; of the other 22, 13 showed a delay of half a minute or less, 4 a delay of half a minute to a minute and a half, and 1 a delay of twenty-five minutes. All but 3 of those with delay were women. In 3 patients, including the one with twenty-five minutes delay, subsequent examination showed organic disease of the stomach as an underlying cause. Fourteen of the healthy individuals with delay were re-examined fasting; 13 then showed no delay, and the amount of retardation in the other was lessened.

LEWIS G. JACOBS, M.D.

Chronic Hypertrophic Antrum Gastritis. Julian Arendt. *Ann. Surg.* 122: 235-252, August 1945.

The author reviews the diagnostic signs of antral gastritis and points out the deceiving similarity to malignant growth. He emphasizes the importance of a complete history referable to the upper gastro-intestinal tract. Golden is quoted as stating that gastritis is frequently accompanied by disturbance in motility, antral spasm, and prepyloric narrowing, as well as hypertrophy of the pyloric muscle. In view of the above statements, the author considers visible pyloric hypertrophy or antral spasm in an adult helpful in the diagnosis of chronic hypertrophic gastritis. A second sign is a change in the mucosal pattern, with swelling, stiffness, and deformity of the mucosal folds, yet without a break in their continuity. If there is a break in their continuity, ulceration is present and a malignant neoplasm is a good possibility. The author states that early opening of the pylorus with a deformed antrum is in favor of carcinoma, while delayed opening with a similar deformity is in favor of antral gastritis.

Seven cases are reported, but the diagnosis of hypertrophic gastritis might be questioned in some of these.

SYDNEY F. THOMAS, M.D.

Invagination of the Stomach: A Case Diagnosed by Means of Roentgen Examination. Kai Dohn and Börge Faber. *Acta radiol.* 26: 56-68, Jan. 22, 1945. (In English.)

A case of gastro-gastric intussusception due to a pedunculated leiomyoma, diagnosed roentgenologically, is reported. Although there was spontaneous reduction in eleven days, the patient died of intercurrent infection. Twenty-four other cases in the literature are reviewed, and references to most of these are included. The condition is usually due to a benign pedunculated tumor. In 6 of the 14 cases studied by roentgenograms, the diagnosis could be established by this means. Clinically the condition mimics pyloric obstruction; a palpable tumor, often associated with bloody vomiting, melena, or anemia, is a common finding.

LEWIS G. JACOBS, M.D.

Solitary and Multiple Carcinomas of the Upper Alimentary Tract: Their Location, Age and Sex Incidence, and Correlation with the Plummer-Vinson Syndrome. Aage Videbæk. *Acta radiol.* 25: 339-350, Sept. 20, 1944. (In English.)

In a study of 1,313 cases of cancer of the upper alimentary tract (extending from the lips to the gastric antrum), the author found significant differences in the site of predilection for the various sex and age groups. In women, tumors predominated in the postcardiac region, the posterior pharyngeal wall, the entrance to the esophagus and its cervical portion. In men, tumors most often occurred in the lower lip, at the base of the tongue, in the piriform sinus, and the lower esophagus. In other regions of the upper alimentary tract, there was no significant difference in tumor occurrence between the two sexes, nor was there any appreciable difference with regard to histologic characteristics which would explain the differences in radiosensitivity in the sexes.

The Plummer-Vinson syndrome was seen less frequently in Denmark than in Sweden, a fact which probably accounts for the considerably smaller percentage of women suffering from upper alimentary tract cancer in Denmark. Multiple carcinoma was observed slightly more often in men than in women. Apparently the upper alimentary canal shows a particular tendency to the occurrence of successive carcinomas.

ERNST A. SCHMIDT, M.D.

A Search for Symptomless Gastric Cancer in 500 Apparently Healthy Men of Forty-Five and Over. Morris E. Dailey and Earl R. Miller. *Gastroenterology* 5: 1-4, July 1945.

In an attempt to discover minimal gastric malignant lesions, a survey was made of 500 white men of forty-five or over, who were free of digestive complaints other than gas or constipation. Anyone who followed an altered diet, even rarely took antacids, or gave a history of gastro-intestinal distress was excluded from the series. All were examined by barium meal and fluoroscopy, and any individual whose stomach showed a hint of abnormality returned for a complete gastro-intestinal series with films. A considerable number of non-gastric abnormalities were revealed and these are listed. The most common cause for requesting films was a prepyloric deformity. Twenty-nine men were suspected of having gastric disease on fluoroscopic examination; roentgenograms were normal in 23 of these cases, probably normal in 3; one patient was

found to have a gastric ulcer; one, antral gastritis; one a suspected antral polyp.

The authors conclude that a survey of the general population in search of gastric cancer is not worth while. Even if a lesion is found, follow-up studies are all but impossible. Mortality rates, autopsy statistics, and hospital census data do not give a full picture of the incidence of silent gastric cancer. Studies of selected groups, as those with pernicious anemia, should be expanded, as this seems a profitable approach to the problem. Since all individuals with the slightest symptoms were excluded from this survey, the authors' results in no way detract from the view that even mild dyspepsia in older persons demands prompt and adequate investigation.

Some Cases of Intestinal Tuberculosis in Phthisics, with Reference Especially to the Prognosis. Sv. B. Larsen. *Acta radiol.* 26: 117-132, Jan. 22, 1945. (In English.)

The author studied 32 cases of pulmonary tuberculosis in which a diagnosis of secondary intestinal tuberculosis was based on laboratory and roentgenologic proof. Twenty-one patients were re-examined after intervals of two to eight years, and of these only 3 showed an entirely normal picture, although at the time most of the groups were asymptomatic, with their pulmonary lesions arrested.

LEWIS G. JACOBS, M.D.

Significance of Cannon's Point in the Normal and Abnormal Functions of the Colon. Julian Arendt. *Am. J. Roentgenol.* 54: 149-155, August 1945.

A point in the proximal mid-third of the transverse colon, corresponding to the contraction ring in the large bowel of animals first described by Cannon, is also found in man and can be demonstrated roentgenologically. The point is visualized as a contraction ring or as the point where distinct changes in filling and contraction of the bowel occur. Thus it may be noted that the ascending colon and the first part of the transverse are contracted while the balance of the colon is of normal caliber, or *vice versa*. It is the author's belief that this is the pivotal point of a change in innervation between the vagus and the pelvis and, on the sympathetic side, between the splanchnic superior and inferior. For roentgen demonstration an antagonism between these neurological units is necessary. Spastic contraction of the distal unit is considered a frequent cause of spastic constipation.

L. W. PAUL, M.D.

Periodic, Spontaneously Remittent Volvulus and the Symptoms in Cases of Colon Elongatum. Flemming Nørsgaard. *Acta radiol.* 26: 163-184, Jan. 22, 1945. (In English.)

Volvulus is often asymptomatic, especially if it involves a twist of 180° or less. Three cases are reported in which a periodic, spontaneously remittent volvulus was diagnosed radiologically. The symptoms were recurrent attacks of abdominal pain for years, occurring without obvious cause and relieved by lying down. Clinical findings were slight, but in all patients radiography showed a localized volvulus in an abnormally long loop of colon, without ileus; an enema or a change of position would straighten out the loop. A number of other cases of elongated colon are presented in which the author thought a similar condition had occurred. A

case of volvulus of the sigmoid accompanied by a coprolith and marked secondary changes is also described.

LEWIS G. JACOBS, M.D.

Radiologic Study of Cecocolic Invagination in the Adult. René-J. Gilbert and J. Garcia-Caldéron. *Acta radiol.* 25: 251-268, Sept. 20, 1944. (In French.)

Basing their conclusions on a case of adenocarcinoma of the cecum described in detail, the authors discuss the various radiological phenomena important for the diagnosis of cecocolic invagination in the adult. Examination with the aid of both the barium meal and the barium enema is considered. It is possible to arrive at a general diagnosis of invagination by a barium meal study, but this method does not permit a differential diagnosis between the two anatomically different cecocolic types. The morphologic signs obtained after the barium meal are: (1) dystopia with ascending passage and dilatation of the terminal loop of the ileum, smooth or dentulated in outline and ending in a beak-like protrusion; (2) lack of visualization of the cecum and of a more or less extensive portion of the right colon and even the transverse colon; (3) narrow intestinal lumen (*défilé entérique*) with longitudinal striation, in extension of the above-mentioned "beak" of the terminal loop of the ileum and exactly following the axis of the colon; (4) lacunar dilatation of the colon by the invagination, the lacunae being bordered by an opaque margin and traversed by either fine mucous folds or dense haustral shadows, producing the so-called "accordion" appearance. Phenomena (1) and (2) may also occur in colocolic invagination. The combination of the phenomena (3) and (4) results in the so-called "five parallel bands" aspect, which is pathognomonic for intracolic invagination.

The signs observed during the barium enema examination may be divided into those seen during the process of filling, during the process of reduction, and after complete reduction. During the process of filling, one observes the arrest of the barium column in form of a cup (without diagnostic significance), in form of a figure 3, in form of a trident or, rather rarely, as a segmentary radiopacity of the central canal. In addition, the so-called "mantle lacuna" may be seen, due to the deeper penetration of the radiopaque medium along the sheath of the invagination. During the process of reduction, the more or less rapid disappearance of the lacuna is noted (similar in appearance to "the withdrawal of a piston from a syringe"). After complete reduction of the invagination, the cecal lacunar picture persists in the case of tumor. By air insufflation and compression the characteristics of the deformity (diminished caliber, sickle-shaped incurvation of the intussuscepted apex, etc.) may be determined. The terminal loop of the ileum will be filled with barium. On the other hand, retraction, festooning of the cecal fundus, and convergence of the mucosal folds may also be due to peritoneal adhesions.

In the differential diagnosis, ileocolic and colocolic invagination must be considered. Tumor, benign or malignant, is the most common cause of cecocolic invagination in the adult.

ERNST A. SCHMIDT, M.D.

Roentgenological Manifestations of Amebiasis of the Large Intestine. A. Druckmann and S. Schorr. *Am. J. Roentgenol.* 54: 145-148, August 1945.

On the basis of roentgen studies, amebiasis of the colon can be divided into two types:

(1) The diffuse type. The roentgenologic appearance is similar to that of idiopathic ulcerative colitis, from which it cannot be distinguished.

(2) The localized type. This has a more distinctive roentgen appearance and is characterized by: (a) the relative length of the stretch occupied by the filling defect of the colon; (b) the often multiple occurrence of obstruction of the lumen; (c) the incompleteness of the narrowing of the lumen as compared to malignant stenosis; (d) the insignificance or even absence of pain upon distention by the barium enema, in contrast to the acute pain of malignant stenosis; (e) the frequently gradual merging of the filling defect into the normal contours of the intestine; (f) the partial maintenance of elasticity of the intestinal wall, evidenced by widening of the lumen upon introduction of barium; (g) the more or less normal mucosal relief in the involved portion, and (h) the more or less complete restoration to normal after vigorous antiamoebic treatment.

L. W. PAUL, M.D.

Two Cases of Internal Biliary Fistulae. Enar Brandel. *Acta radiol.* 25: 333-338, Sept. 20, 1944. (In German.)

Internal biliary fistulae have been known for a long time and are, as a rule, easily recognized by radiography. Kehr reported a 5 per cent occurrence in his large material of gallbladder operations while Prévôt observed them only in 0.39 per cent of his autopsy cases. The most common causes of internal biliary fistulae are cholelithiasis, duodenal or gastric ulcers, and occasionally cancers. In about half of the cases there exists a communication between the gallbladder and the duodenum; in about one-third of the cases between the gallbladder and the colon; in about 10 per cent between the gallbladder and the stomach. Only in very rare cases do the fistulae involve the appendix, the thoracic cavity, the urinary tract, or the uterus. Due to the vagueness of symptoms, the clinical diagnosis without radiography is extremely difficult. Two cases diagnosed and observed by the author are described in detail.

ERNST A. SCHMIDT, M.D.

THE DIAPHRAGM

Traumatic Right Diaphragmatic Hernia: Case with Delayed Herniation of the Liver and Gallbladder. Clifford H. Keene and Benjamin Copleman. *Ann. Surg.* 122: 191-196, August 1945.

Traumatic hernia rarely occurs through the right hemidiaphragm. The incidence as given by Hedblom (*Ann. Int. Med.* 8: 156, 1934), on the basis of the literature, is 5 per cent. In a series of 857 traumatic hernias, he found the liver to be involved in only 14 (1.6 per cent).

In the authors' case, which followed a plane crash, films made immediately after the accident showed no herniation. About three months later, the patient began to have pain in the right lower thorax, which was worse after eating. Peristaltic gurgles were heard high in the right axilla. A chest film now showed a homogeneous shadow in the right lower thorax, while abdominal films failed to demonstrate the lower margin of the liver. A barium enema study showed the hepatic flexure to be unusually high in position. It was assumed, therefore, that the liver had migrated into the

chest, and to confirm this impression, cholecystography was done. It revealed "a markedly elongated, narrow gallbladder, the fundus of which was directed upward toward the right axilla." At operation for repair of the hernia, the liver was found in the right thorax, lying completely upside down. The right hemidiaphragm was contracted and shrunken posteriorly and medially. The gallbladder was stretched into a long, thin, tube-like structure extending from the posterior-superior portion of the chest down into the abdomen.

The liver was rotated 180° into its normal position and the rent in the diaphragm was repaired after crushing the right phrenic nerve. Postoperative cholecystograms showed a normal appearing gallbladder.

[The shadow interpreted as the distorted gallbladder in the reproduction of the cholecystogram is not too convincing.—S.F.T.] SYDNEY F. THOMAS, M.D.

Four Cases of Diaphragmatic Intumescence. Aage Wagner. *Acta radiol.* 26: 239-247, Jan. 22, 1945. (In English.)

The author reports 4 cases in which there was a pronounced upward bulge of the diaphragm at the right cardiophrenic angle. In 3 the diagnoses were, respectively, congenital short esophagus with hiatus hernia, subdiaphragmatic cyst, and diaphragmatic hernia containing liver tissue. The fourth case was thought to be a pericardial lipoma, but the diagnosis is unconfirmed.

LEWIS G. JACOBS, M.D.

THE MUSCULOSKELETAL SYSTEM

Osteomyelitis Caused by Granuloma Inguinale: Report of a Case with Cultivation of the Donovan Body in the Yolk Sac of the Developing Chick Embryo. Walter H. Sheldon, Ben R. Thebaut, Albert Heyman, and Margaret J. Wall. *Am. J. M. Sc.* 210: 237-245, August 1945.

Although extragenital lesions of granuloma inguinale are not uncommon, skeletal involvement is rare. Such lesions are generally believed to be the result of contact infection, but the occasional occurrence of multiple widespread extragenital lesions has suggested a hematogenous dissemination. In support of a systemic disease, also, are the cases of bone lesions without the occurrence of skin ulcers.

A case of osteomyelitis due to granuloma inguinale is reported in a 43-year-old colored male. He struck his shin about six months before admission and sustained a bruise, which persisted. He injured the bruised area again and an ulcer formed. His knee subsequently became stiff. Three weeks before admission a small erosion of the penis adjacent to the corona was observed. The patient insisted that the ulcer on his leg had been present for a long time before the appearance of the penile lesion. The blood Kahn reaction was negative. The sedimentation rate was 125 mm. in one hour. The Ducrey and tuberculin skin tests were positive. The Frei test was negative, but the complement-fixation test for lymphogranuloma venereum was positive.

Roentgenograms of the leg showed a large bone defect, about 4 cm. in diameter, in the proximal portion of the tibia at the level of the tubercle. The cavity was surrounded by moderately sclerotic bone. There was irregular thickening of the adjacent periosteum. The other bones were normal except for a cystic area in the anterior portion of one of the ribs. The clinical impres-

sion was that the lesion was a tumor. Biopsies from the granulation tissue of the leg, and later from the penis, showed granuloma inguinale. Donovan bodies were isolated in pure culture by inoculation into yolk sacs of chick embryos of a portion of the biopsy material. Biopsy of the lesion in the rib showed no evidence of granuloma inguinale. Treatment consisted of Fuadin intramuscularly, and sulfonamide powder and tyrothrycin locally to the lesions in the leg and penis.

Only 4 other cases have been found in the literature in which the diagnosis was proved by histologic examination. There are recent reports of arthritic manifestations with extensive lesions in the joints of the hands and feet. Occasionally there has been noted an elevation of the serum globulin and the alkaline phosphatase.

BENJAMIN COPLEMAN, M.D.

On Reticulum Cell Sarcoma in the Bones. Thomas Rosendal. *Acta radiol.* 26: 210-221, Jan. 22, 1945. (In English.)

The author discusses 4 cases of reticulum-cell sarcoma metastatic to bone and a fifth case of generalized periosteal reticulum-cell sarcoma, a condition not previously described. In 3 instances the lesions were osteolytic, in 1 osteoblastic, and in 1 there was vertebral collapse only. The prognosis under roentgen therapy is comparatively good, with some prospect for a permanent cure.

LEWIS G. JACOBS, M.D.

Malignancy of Giant Cell Tumors: A Study on Giant Cell Tumors and Allied Affections in Bone, with Reference Specially to Their Malignancy. Sigurd Ry Andersen. *Acta radiol.* 26: 11-35, Jan. 22, 1945. (In English.)

This report covers 48 cases diagnosed as giant-cell tumor including all cases adequately examined at the Radium Center in Copenhagen and in the Finsen Institute between 1930 and 1943. Most cases were referred from other hospitals, and several were recurrences. One case (in the femur) was probably a primary osteogenic sarcoma, wrongly diagnosed. The other 47 were distributed as follows:

Giant-cell tumors in epiphyses of the long bones.....	11
Giant-cell tumors in short bones or soft tissues.....	3
Osteitis fibrosa in long bones.....	8
Osteitis fibrosa generalisata.....	3
Giant-cell tumor of upper jaw.....	1
Osteitis fibrosa of upper jaw.....	2
Epulis gingivae.....	19

The pathological picture was enormously varied, and the author was unable to distinguish by microscopy the cases which might be considered true neoplasms. In only one case (head of the right humerus) did malignant change occur, three years following roentgen therapy. This was confirmed by repeated microscopic study. The important point clinically is "that an osteogenic sarcoma in the beginning not infrequently may to the point of deception resemble a benign giant-cell tumor, and particularly that the roentgenologic pictures of the two conditions may be exactly alike; so that the possibility of the case being an osteogenic sarcoma cannot be excluded with certainty except

on the basis of a histologic examination." Since occasional giant-cell tumors may become malignant, it is necessary to repeat the biopsy if new symptoms supervene. Unnecessary mutilating operations should be avoided. While it is not generally agreed whether surgery is the treatment of choice, the author leans in that direction. The use of both forms of treatment offers no advantage.

LEWIS G. JACOBS, M.D.

Cystic Forms of Cancer Metastases in Bone. Bengt Engfeldt. *Acta radiol.* 25: 317-324, Sept. 20, 1944. (In French.)

Cystic cancer metastases of the bone are rare. According to Engfeldt, only 4 cases have been described in the medical literature: 2 following cancer of the breast, 1 following cancer of the esophagus, and 1 after cancer of the prostate. He adds a case following adenocarcinoma of the lung with mucous secretion. The metastases occurred in the spine, pelvis, right femur, tibia, sternum, and clavicles. The metastatic involvement gave rise to no symptoms and was discovered incidentally during a chest examination for cough and shortness of breath. The metastases ranged from pea to hazelnut size and occurred both as isolated lesions and in groups. The peculiar cystic character of these metastases is probably due to two factors: the abundant mucous secretion of the tumor cells and their tendency to slow and expansive growth. The walls of the metastatic cysts exhibited both osteoclastic and osteoplastic characteristics.

ERNST A. SCHMIDT, M.D.

Isolated Myeloma in a Fourteen Year Old Boy. Justus Kaufman. *Am. J. Surg.* 69: 129-132, July 1945.

A case of isolated myeloma of the skull in a fourteen-year-old boy is presented. The chief complaint was persistent localized pain of two weeks' duration, in the right occipital region, and a suddenly enlarging mass in this area. Past illnesses were negligible with the exception of a severe trench mouth, three months previously. The only abnormal finding on examination was a cystic mass 3/4 inch in diameter over the right occipital bone. This was not freely movable and was tender to palpation. A roentgenogram revealed an area of bone rarefaction in this region, with a characteristic punched-out appearance. The skull was otherwise normal. Complete x-ray studies of the skeleton disclosed nothing further of significance.

At operation, as much of the tumor was removed as possible, and the edges of the bone were everted. The histologic diagnosis was myeloma. Postoperatively a total of 1,755 r was administered through a small portal to the right occipital region in fractionated doses over a thirty-three-day period. The factors were 200 kv., 6 ma., 1 mm. Cu filter, 60 cm. distance. Complete epilation followed, but later there was a growth of new hair. Roentgenograms of the skull approximately four years after the removal of the tumor showed the defect in the skull almost completely replaced by bone. At that time the patient seemed well in every respect.

An isolated myeloma is an unusual finding, particularly in a young boy. Dr. James Ewing, who saw this patient, suggested that the severe mouth infection might have been an exciting factor in the production of the tumor. It is of interest that a first cousin of the patient died of myelogenous leukemia at the age of twelve.

Late Bone Lesions in Caisson Disease. Three Cases in Submarine Personnel. C. C. Michael James. *Lancet* 2: 6-8, July 7, 1945.

Three men were examined twelve years after a single severe attack of "bends" as a result of being trapped for two and a half to three hours under increasing pressure in a submarine sunk in a collision to a depth of 120 feet. The men were of similar age and experienced the same conditions, but the bone lesions were much more severe in one case, probably because this man had struggled violently to open a stop-cock at the time of the accident. It is thought that the increased circulatory rate during the recovery period following his strenuous activity would tend to permit more rapid absorption of the gases while the pressure was increasing, and more complete distribution through the body. The increasing atmospheric carbon dioxide was believed to be a factor in the severity of the lesions.

Roentgenograms in the three cases showed small rounded areas of rarefaction surrounded by a thin shell of hypercalcification in the ends of the long bones, confirming the pathology of infarction followed by aseptic necrosis and incomplete repair. In the severe case the heads of both femora had partially collapsed, resulting in well marked osteoarthritis deformans.

Rickets in Iceland. Niels Dungal. *Am. J. M. Sc.* 210: 70-76, July 1945.

Because rickets in Iceland rarely occurs in its most extreme forms, the work of Thoroddsen, who found the disease in 51.5 per cent of children up to two years of age, has been doubted.

The author examined 239 Icelandic children from three months to two years old. Clinically special attention was paid to the fontanelles, parietal prominences, occipital flattening and hairlessness, rachitic rosary, Harrison's groove, and deformities of the extremities. No single sign was considered sufficient for a diagnosis. A distinct rachitic rosary practically never occurred alone. Few signs were found in the extremities.

Roentgenograms of a knee, wrist, and particularly of an ankle were taken of each child. The principal diagnostic criterion was the appearance of the line of calcification at the epiphysis. Instead of being straight, clear-cut, and narrow, as in normally growing bone, the line is indistinct, indented, and broken. In severe cases only a broad band of uncalcified tissue is seen; eventually the distal end becomes broad and concave. The trabeculae of the spongiosa become blurred and the diaphysis loses its strength and straightness. The medial articular margin of the tibia appears to be broader and flattened so that the condyle becomes pointed. Sometimes the lateral condyle also assumes this appearance. While the roentgenographic findings in the author's series generally conformed to the clinical findings, occasionally unmistakable clinical signs were present when no definite radiologic signs could be found.

The author found 77 per cent of all children to have rickets. His survey showed that every child would develop rickets unless some kind of prophylaxis was received. It appeared that the usual cod-liver oil dosage was insufficient, and that only those children had normal bones who had had artificial sun baths for a long period of time. Because of the long dark winter months, specific antirachitic therapy is required. The long summer days do not afford adequate protection.

BENJAMIN COPLEMAN, M.D.

Infantile Dwarfism (Encephalomyelitis) in Siblings. John Monfort, Slik H. Polayes, and Reuben Sorkin. *Am. J. Dis. Child.* 70: 4-8, July 1945.

Detailed case histories are presented of two sisters who apparently ceased to grow mentally or physically after the age of three months. The facts that these children were the offspring of parents (Italian) who were first cousins and that the mother had 8 miscarriages in 15 pregnancies suggest a possible inherited familial background or constitutional factor contributing to the etiology. Both pregnancies were uneventful, no forceps were used in the deliveries, which were normal, and no immediate postnatal complications developed.

The older child weighed 7 1/2 pounds at birth in 1935 and only 8 pounds 2 ounces at the time of writing, when she had reached the age of seven and a half years. Muscular spasms began at the age of three months, and the child gradually assumed an attitude of spastic flexion of all joints. Laboratory examinations at five years of age, including blood chemistry, blood cell and differential counts, urinalysis, and Wassermann tests, were essentially negative. An electro-encephalogram showed practically no cerebral activity.

Roentgen examination of the skeleton showed varying stages of development from two months to eight years. All bones had a ground-glass appearance, with definite thinning of the cortex and a corresponding wide medullary space. The calvarium showed all fontanelles entirely closed and bone thickness of a two-year-old child. The semicircular canals, usually not visualized after two months of age, were very distinct. There was prognathism of the maxilla and recession of the mandible, but the diminution of the width and depth of the posterior and middle fossae characteristic of microcephalus was not present. The pituitary fossa was very small. The frontal sinuses were present. Encephalograms revealed cystic dilatations in the mid-brain. Development of the epiphysis of the head of the humerus approximated that of an eight-year-old but the carpals showed only three ossification centers, typical of a two-year-old. The lower extremities averaged a bone age of five years.

The younger sister exhibited similar findings on hospital admission, at the age of two years. She died unexpectedly about eight months later. Autopsy revealed an external hydrocephalus with pressure atrophy of the pituitary gland and cerebral degeneration and atrophy, especially of the cortical ganglion cells. The pars intermedia was cystic. The thymus had almost completely retrogressed and was represented by a small quantity of connective and lymphoid structure with complete calcification of a few corpuscles. The thyroid was small, showing a number of areas of fetal parenchyma, although the remainder of the gland was of normal structure. The adrenal glands showed medullary hypoplasia. LESTER M. J. FREEDMAN, M.D.

Case of Cleidocranial Dysostosis. Helge Eltorn. *Acta radiol.* 26: 69-75, Jan. 22, 1945. (In English.)

The author reports a case of cleidocranial dysostosis in a woman 52 years old. There were also failure of development of the permanent teeth, maldevelopment of the wrists and elbows, brachyphalangia, bilateral coxa vara, and maldevelopment of the thoracic vertebral bodies. The patient's mother also had cleidocranial dysostosis, but no other member of the family.

LEWIS G. JACOBS, M.D.

Hereditary Multiple Exostosis. Review of the Literature and Report of a Case with Horner-Bernard Syndrome as a Complication. Lloyd D. Fisher, Clare Parsons, and Cecil C. Cutting. *Permanente Found. M. Bull.* 3: 124-136, July 1945.

A case of hereditary multiple exostosis, with one lesion arising from the third rib and producing a Horner's syndrome, is presented. Approximately half of the members of the patient's family were affected with exostotic lesions. Roentgenograms are reproduced.

The confusion of nomenclature in hereditary multiple exostosis is discussed. The literature is reviewed, and the clinical picture, pathology, pathogenesis, eugenic implications, and etiology are considered.

Case of Cystic Tuberculosis in Bone and Joint. Ingolfur Blöndal. *Acta radiol.* 25: 366-371, Sept. 20, 1944. (In English.)

The author describes a case of tuberculosis of the left hip joint combined with a cystic process in the upper part of the femur. Repeated examinations showed spread to the adjoining portions of the femur, the acetabulum, and the pelvis. The course of the disease was slowly progressive, but a definite healing tendency was obvious after about eight years' duration. At this time, however, the patient, who had been observed from the age of three years to the age of eleven, died of miliary tuberculosis.

The diagnosis of tuberculosis of the hip joint in this case is based on the clinical picture, the strong tuberculin reaction, and the death from miliary tuberculosis. There was no confirmation by histologic examination or by demonstration of tubercle bacilli.

ERNST A. SCHMIDT, M.D.

Osteochondritis Dissecans of the Supratrochlear Septum. W. S. Millman. *Canad. M. A. J.* 53: 55-57, July 1945.

Osteochondritis dissecans consists in a necrotic process which separates a bone fragment beneath an articular cartilage. This fragment may later become a loose body in the affected joint. Trauma is considered the most probable etiologic agent. The disease is one of young adults, usually males, and most commonly involves the medial femoral condyle, but has been described elsewhere.

The author presents the findings in a man of 29 years who complained of pain in the elbow and inability to completely extend the joint. There was a history of injury fifteen years previously but there had been no intervening disability and no recent trauma. Radiographic study revealed a small loose fragment in the elbow joint space on the medial side and a punched-out defect in the supratrochlear septum with a fuzzy outline. The opposite elbow was normal. The fragment was removed surgically and on pathologic study diagnosed "osteochondroma." The patient was relieved of his symptoms.

BERNARD S. KALAYJIAN, M.D.

Osteochondritis Dissecans of the Head of the Femur. Ivan Hermodsson. *Acta radiol.* 25: 269-304, Sept. 20, 1944. (In German.)

The cases of osteochondritis dissecans of the femoral head may be divided into two groups: primary and secondary. The first stage of primary osteochondritis

dissecans is represented by aseptic necrosis, forming a focus of lessened resistance. Under the influence of strain or injury, a pathologic fracture develops in the most exposed part of the head, i.e. in the upper pole. This fracture engenders aseptic necrosis, which results in osteochondritis dissecans. This theory, originally formulated by Axhausen, is supported by the fact that, as a rule, the disease affects hard-working laborers. Secondary osteochondritis dissecans is observed in cretinism and in fractures of the femoral neck. Multiple hereditary anomalies of the epiphyses (Ribbing type) and multiple osteochondritis dissecans probably belong to the secondary category.

The author describes several cases of an intermediate form between Perthes' disease and osteochondritis dissecans. For these latter forms the term "osteochondritis deformans dissecans" or "osteochondrosis deformans dissecans" is suggested.

ERNST A. SCHMIDT, M.D.

On the Incidence of Osteochondrosis. Sv. A. Chrom. *Acta radiol.* 26: 49-55, Jan. 22, 1945. (In English.)

Osteochondrosis is defined as the syndrome characterized by low back pain accompanied by a narrowed intervertebral disk (usually fifth lumbar) with hypertrophic changes and sclerosis of the borders of the adjacent vertebral bodies. There may also be a relative displacement of the bodies, simulating a spondylolisthesis. The material evaluated consists of one year's patients, 50 women and 82 men, and of these 20 had the characteristic picture. As controls, 63 patients without back pain were studied (they had been referred for barium enema), comprising 37 women and 26 men. Of these, 2 showed typical changes, but on further questioning 1 of the 2 was found to have characteristic symptoms and appears to have been included among the controls by accident. The other represents an incidental asymptomatic osteochondrosis. Spondylolisthesis deformans and prolapse of the nucleus pulposus are to be differentiated, the latter by myelography.

LEWIS G. JACOBS, M.D.

Rheumatoid Spondylitis, with Special Reference to Early Diagnostic Criteria. Arthur J. Present. *Calif. & West. Med.* 63: 10-13, July 1945.

In an eighteen-month period, 75 young men with rheumatoid spondylitis were admitted to an Army General Hospital. In such cases an early diagnosis and prompt institution of treatment are essential for alleviation of symptoms. The roentgen diagnosis is based primarily on the identification of typical rheumatoid arthritic changes in the sacroiliac and apophyseal joints. Contrary to the experience of Oppenheimer (*Am. J. Roentgenol.* 49: 49, 1943. *Abst. in Radiology* 41: 306, 1943), the author found no instance of apophyseal involvement without definite sacroiliac manifestations. The simple anteroposterior view of the lumbosacral spine was found to be most satisfactory for demonstrating the pathological changes. For the apophyseal joints 45-degree-angle films gave the best visualization.

On the basis of the roentgen findings a series of 50 patients is divided into three groups. The first group consisted of 24 patients with minimal sacroiliac joint changes, with or without apophyseal joint involvement. In most instances the changes were bilateral.

The joints showed a hazy, blurred, or ground-glass appearance. The sharp penciled double lines about the inferior cartilaginous portion of the joint had become broken or disappeared, so that the margin was broadened and irregular. There was no rarefaction of the vertebral bodies and no ligamentous calcification in these early cases. Loss of the normal lumbar curve was a striking feature in some instances. Nineteen moderately advanced cases constituted the second group. These patients showed more pronounced sacroiliac manifestations, usually associated with apophyseal changes, especially in the lumbar area. Rarefaction of the adjacent ilium was frequent, as were mottling and a loss of trabecular definition. Fragmentation, scalloping, and obliteration of the joint margins was observed. In the apophyseal joints erosion, with roughening or scalloping of the facets, was visible, and the joint spaces were narrowed. Calcification of the spinal ligaments was observed in 9 cases of this group. In the third group, consisting of 7 advanced cases, the picture ranged from ankylosis of the sacroiliacs and one or more apophyseal joints, with or without ligamentous calcification, to extensive ankylosis of all the diarthrodial joints of the entire spine, including the costovertebral articulations.

The author adds that radiotherapy is apparently effective in arresting the progress of the disease.

MAURICE D. SACHS, M.D.

On Bechterew's Disease from the Roentgenologic Point of View. Kristian Overgaard. *Acta radiol.* 26: 185-209, Jan. 22, 1945. (In English.)

After discussing the symptoms and pathology of ankylopoietic spondylarthritis, or Bechterew's disease, the author describes the roentgen changes. The sacroiliacs are often involved in the early stages, the characteristic picture being a scattered, slightly cloudy group of opacities about the joint, with subchondral spotty decalcification and vague, blurred demarcation. Confluence of small rarefactions may give the appearance of widening of the joint; this is more common in the lower portion. Osteophytes may be formed across the joint. As the disease progresses, the new bone formation predominates and the joint pattern is effaced by new-formed, slightly compact osseous tissue, through which remnants of the articular outlines can often be distinguished. In far-advanced cases, every vestige of the joint may be effaced. These characteristic changes were present in all (31) of the author's cases. Changes in the vertebrae are less important from the standpoint of diagnosis because, though they are distinctive, they are of relatively late appearance. Sometimes slight halisteresis of the vertebral bodies (seen only on the lateral view) is an early change. Flattening of the lumbar lordosis and a highly placed arcuate thoracic kyphosis without change in the individual vertebrae are characteristic. Changes in the intervertebral articulations are shown in the oblique view in most cases. Later calcifications occur in the ligaments. These findings make diagnosis easy.

Fourteen of the author's patients were given roentgen therapy (180 kv., 1 mm. copper and 1 mm. aluminum filter, 10 × 15-cm. fields, maximum 4 fields, 150 to 200 r × 2 per treatment). The immediate symptomatic improvement was good and was sustained in 9 of the 10 patients followed (from one to four years).

LEWIS G. JACOBS, M.D.

Duvernay's "Forage" of the Femoral Epiphysis: Follow-Up Examination of 41 Cases. Jørgen Ernst. *Acta radiol.* 26: 76-88, Jan. 22, 1945. (In French.)

The operation discussed here consists of boring one or more holes in the head and neck of the femur, which may or may not then be filled with dead bone. The pain of arthroses of the hip is relieved and the condition improved by the procedure. The mode of action is not clear. The operation is most effective in cases characterized by osteoporosis and cyst-like degenerations in the bone; in the type characterized by sclerosis and osteophyte formation with cystic degeneration it is less effective.

Forty-one such operations were done in 39 patients in the fourth to the eighth decades, with symptoms for less than one to over thirty years. In 8 the changes were secondary to trauma. Immediately after the operation, 90 per cent of the hips were painless or improved; after six months, 76 per cent; after 2 years, 70 per cent; after six years, 64 per cent. Improvement of motion was noted in a third of those whose pain was alleviated, but in only 10 per cent of those clinically unimproved. In many of the cases with clinical betterment, improvement was also demonstrable roentgenographically.

LEWIS G. JACOBS, M.D.

Para-Articular Calcification (Pellegrini-Stieda) in Affections of the Knee. I. William Nachlas and John L. Olpp. *Surg., Gynec. & Obst.* 81: 206-212, August 1945.

Observations on 20 men with calcific deposits medial to the lower end of the femur were supplemented by a study of one operative and one autopsy specimen and dissections of the area in 9 cadavers.

The calcified masses are shown roentgenographically to be in the soft tissues on the medial aspect of the knee, directly overlying the adductor tubercle. They may be a centimeter or more in length and are plaque-like in form, conforming generally to the contour of the underlying bone, being straight, curved, or S-shaped, depending on their length. They sometimes appear to be attached to the bone, but in such cases further examination with a change of position will show them to be separate.

Studies of the operative and autopsy specimens showed a white fibrous membrane covering the tibial collateral ligament, adductor tubercle, and tendon of the adductor magnus, traversed longitudinally by three small parallel veins. This glided easily over the adductor tubercle on flexion of the knee. The under surface was a bony, button-like plaque, adherent to the contour of and in contact with the periosteum of the adductor tubercle, but separated from it and without real position of the Pellegrini calcification. This is considered the typical.

In the authors' series trauma appeared to be a frequent but not indispensable etiologic factor. Since cases, they too are considered to play a causative role. The trauma may take the form of a single severe tear or may be the cumulative effect of a process of attrition little or no attention. This process is speeded by the swelling of the tissues induced by a systemic or long-standing traumatic arthritis. As a result of the degenerative process affecting the under surface of the membrane, the tensile strength is reduced so that a rela-

tively moderate injury may cause an incomplete tear. This rupture is associated with a laceration of small blood vessels producing moderate bleeding. The small hemorrhage is trapped locally and is molded in its position by the outer coating of the membrane. The encapsulated hematoma thus formed undergoes degenerative changes which, under the proper physical and chemical conditions, lead to calcification. The authors believe that many cases can be recognized clinically, if careful palpation of the region of the adductor tubercle is added to the usual clinical procedures.

As mentioned above, there was in all the patients of the present series an associated arthritis of the knee joint, as shown by bony lipping, a thickened capsule, and sometimes by joint fluid. This arthritic process rather than the calcification is considered by the authors to be the major disabling factor, the calcification itself being of little significance in the production of symptoms.

Treatment of the arthritis is not considered here. For the calcification, conservative measures are usually sufficient.

ARTHUR W. PRYDE, M.D.

Air Arthrography in Diagnosis of Torn Semilunar Cartilage. E. G. Herzog. *Lancet* 2: 5-6, July 7, 1945.

In 12 cases of injury to the knee joint, a diagnosis could not be made by simple clinical means and air arthrography was carried out. A torn semilunar cartilage was diagnosed in 8 of these cases and excluded in 4. Operation or the subsequent history confirmed the findings in 10 instances.

The author's technic is as follows: The leg is prepared as for operation and the procedure is carried out under full aseptic conditions. A No. 20 needle is inserted into the suprapatellar pouch after injection of a little novocain. Any effusion is aspirated. Air, filtered through several layers of gauze, is injected with a 20 c.c. syringe fitted with a three-way tap. In the series reported the amount of air used varied between 60 and 120 c.c., depending upon the distention produced and the amount of pressure needed to push home the piston. A collodion dressing is applied and a bandage is used to compress the suprapatellar pouch and increase the amount of air in the joint. With the patient on his side, the line of the knee joint is marked under the fluoroscope. This is important because the beam must pass exactly along the joint line if overlapping in the film is to be avoided, and since this line by no means always runs at an exact right angle to the long axis of the limb, it cannot otherwise be estimated. With the tube horizontal and the central beam passing through the knee tangentially, three views are taken of the cartilage. The joint should be opened by abduction (adduction when the external cartilage is suspected) of the leg over a sandbag. If other joint lesions are suspected, the usual three views of the whole knee joint can be taken. A film showing the retropatellar space will disclose chondromalacia patellae if it is present.

No case of sepsis followed this procedure, and none of the patients complained of pain.

"Metastatic" Calcification in Soft Tissues of Legs in Osteitis Deformans: Case Report. Bernard Seligman and Louis Nathanson. *Ann. Int. Med.* 23: 82-91, July 1945.

"Metastatic" calcification in the soft tissues has been reported in only one previous case of osteitis deformans

(Wells and Holley: *Arch. Path.* 34: 435, 1942). Metastatic calcification is to be distinguished from calcinosis. The former represents calcification of apparently healthy tissue due to changes in the composition of the blood calcium and phosphorus salts, phosphatase, or alkalinity. The latter represents another stage of an underlying pathologic process such as occurs in scleroderma, sclerodactyly, Raynaud's disease, etc.

The authors' patient had advanced Paget's disease of all the skeletal structures, demonstrable roentgenographically. The disease appeared to be most marked in the skull, pelvis, spine, and lower extremities. The skull, in particular, was tremendously enlarged, having a scaphocephalic configuration with considerable flattening. The maxillary, ethmoidal, and sphenoidal sinuses were obliterated by overgrowth of bone. The bones of the base of the skull were dense and burned, with similar alterations in the temporal bones. In addition to the advanced distortion of the pelvis due to Paget's disease, a flattening and deformity of the hips producing a coxa vara configuration were apparent.

The lower extremities, in addition to evidence of Paget's disease, showed extensive calcification of a granular and mottled type within the soft tissues. This was most pronounced in the subcutaneous tissue and extended through the muscle planes particularly along the mesial and posterior surfaces from below the level of the knee to above the ankle joint. The patient had had edema and venous stasis of the legs, due to heart failure, for eight years. There was no soft-tissue calcification in the upper extremities.

Moderately advanced calcification was present in the abdominal and pelvic vessels, but no calcification in the popliteal or tibial vessels at the level where the soft-tissue calcification was found. Several fractures of both lower extremities were seen, which healed normally. The soft-tissue calcification was apparently not related to the fractures. Minimal calcification was present in the thoracic aorta and mottled changes could be demonstrated through both lungs, many of which had a circumscribed appearance suggesting calcification within pulmonary vessels.

It is difficult to explain with the information at hand why calcification of the soft tissues of the body occurred in this case. In osteitis deformans a negative calcium and phosphorus balance is present in the earlier and more active form of the disease. A positive balance occurs in the later and less active stages, with blood calcium and phosphorus levels normal throughout. The serum phosphatase, however, is increased during the entire disease, sometimes to extremely high levels.

The authors stress the absence of chronic renal insufficiency which can be associated with the protracted presence of calcium and phosphorus ions in the blood in concentrations far in excess of those at which deposition of calcium phosphate may be expected theoretically. They believe that the edema of the lower extremities played an important etiologic role. The patient had received viosterol and calcium over a period of one and a half years, but no significance is attributed to this.

STEPHEN N. TAGER, M.D.

Tissue Calcification and Renal Failure Produced by Massive Dose Vitamin D Therapy of Arthritis. T. S. Danowski, A. W. Winkler, and J. P. Peters. *Ann. Int. Med.* 23: 22-29, July 1945.

Two cases of renal damage secondary to prolonged therapy with vitamin D are described in detail. In one

of these extensive calcification of soft tissues was readily demonstrable.

The first patient was a woman originally seen in 1932 for a painful deforming arthritis of the extremities, of eighteen years' duration. Laboratory studies at that time were within normal limits. Roentgen examination of the right wrist and hand and of the hips showed narrowing of the joint spaces with thinning of the adjacent bone but no generalized osteoporosis. From 1936 to May 1942 the patient received 150,000 to 200,000 units of vitamin D daily. In November 1942 she returned to the hospital with localized fluctuant swellings at the left wrist and right ankle. Laboratory studies now showed anemia and renal insufficiency. The findings included azotemia, urine of low specific gravity, albumin 2 plus, casts, decreased excretion of phenolsulfonphthalein, and a high serum calcium and phosphorus. Roentgenograms showed decalcification of all bones except the skull, narrowing or destruction of joint spaces, and extensive calcific deposits in the soft tissues of the hands, wrists, and right ankle. No calcification was demonstrable in the abdominal organs.

Two and a half years after cessation of vitamin D therapy, serum calcium and phosphorus values had returned to normal; the non-protein nitrogen of the blood was still high, but the urine was free of albumin and casts. Roentgenograms revealed a striking decrease or complete disappearance of calcium in the soft tissues of the hands, wrists, and ankle. In addition, complete destruction and absorption of some of the bones of the wrists were evident, together with concentric decrease in the head of the right femur and movement of the right acetabular surface upward.

The second patient was admitted for intermittent abdominal cramps, nausea, and vomiting, of three months' duration. On her physician's advice, she had been taking vitamin D for seven months for relief of arthritic pain. The initial daily dose of 50,000 units was increased in the course of eight weeks to 500,000 units, at which level it was maintained for five months, being discontinued two months before admission. Laboratory studies revealed hypochromic anemia, an elevated blood non-protein nitrogen content, urine of low specific gravity, and poor excretion of phenolsulfonphthalein dye. A distinct hypercalcemia existed, together with an increased concentration of serum phosphorus. The skull was osteoporotic; proliferations of bone were seen at the knee and hip joints, and on the vertebral bodies, of the type associated with hypertrophic osteoarthritis. There was no metastatic calcification. Repeated serum calcium and phosphorus determinations showed a gradual return to normal values during the next twelve weeks.

These two cases indicate that vitamin D in large doses provokes a hypercalcemia and increases the calcium content of the soft tissues, particularly of the kidney. The hypercalcemia favors metastatic calcification. This may be facilitated by local tissue injury already present, or produced by the vitamin D itself. Calcification in the kidney affords a satisfactory explanation of the renal damage even though, in the cases here recorded, the calcium deposits were too low in concentration to be demonstrated in roentgenograms. This impairment of renal function by vitamin D is to a considerable extent reversible.

The extensive destruction of bone evident in the wrists and right hip of the first patient is an anomalous development in the natural course of atrophic arthritis.

It suggests that the extensive intake of vitamin D together with a low intake of calcium and phosphorus produced disruption of the histology of the bone, of the type reported in rats, with subsequent absorption of the injured bone. During the first five of the six years of therapy this patient did not drink milk nor did she receive supplementary calcium.

No clear principle has been formulated for a rational use of vitamin D in arthritis. Clinical improvement reported during its administration is not correlated with any consistent alteration in the density of the skeleton or of exostoses. In serial roentgenograms the osteoporosis may increase, decrease, or remain unchanged. There is no evidence that improvement is related to the development of hypercalcemia. It seems clear, therefore, that the favorable effects reported are unrelated to the metabolism of calcium and phosphorus, which is not surprising in view of the repeated failure to demonstrate any definite abnormality in the calcium and phosphorus balance of patients with arthritis. That treatment with vitamin D demands careful supervision is obvious.

STEPHEN N. TAGER, M.D.

Fatigue Fracture of the Tibia. Three Cases at a Naval Training Establishment. Trevor P. Mann. *Lancet* 2: 8-10, July 7, 1945.

Three cases of fatigue fracture of the tibia in adolescent naval recruits were encountered in six weeks at a training establishment. The clinical and radiological findings suggest that the condition is a well defined entity. The author believes that the paucity of published cases in Great Britain during the war indicates that the condition is being overlooked in the Services.

Fatigue Fracture of Femur and Tibia. H. R. I. Wolfe and J. M. Robertson. *Lancet* 2: 11-13, July 7, 1945.

Two cases of fatigue fracture, one of the tibia and the other of the femur, are reported. These illustrate the occurrence of such lesions in healthy young adults undergoing intensive training and the need for thorough treatment.

Stress Fracture of Femoral Neck. John A. W. Bingham. *Lancet* 2: 13-14, July 7, 1945.

A case of stress fracture of the femoral neck is presented. This case differs from others so far reported in that there was a basal fracture of the neck of the femur with varus deformity, such as occurs typically in fractures due to gross violence. From cross-questioning of the patient it was learned that he had suffered no gross injury. Slight pain had come on immediately after a training exercise, becoming much worse a few days later. From the history it seems probable that the fracture had at first been a crack without displacement and that subsequently the fragments separated and became displaced, with increasing pain.

THE GENITO-URINARY SYSTEM

Renal Hypoplasia with Hydroureter and Primary Amenorrhea. Report of a Case. Frank M. Huff and William P. Boger, Jr. *J. Urol.* 54: 116-122, August 1945.

The authors call attention to the frequent association of genital and upper urinary tract anomalies, particu-

tively moderate injury may cause an incomplete tear. This rupture is associated with a laceration of small blood vessels producing moderate bleeding. The small hemorrhage is trapped locally and is molded in its position by the outer coating of the membrane. The encapsulated hematoma thus formed undergoes degenerative changes which, under the proper physical and chemical conditions, lead to calcification. The authors believe that many cases can be recognized clinically, if careful palpation of the region of the adductor tubercle is added to the usual clinical procedures.

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Air Arthrography in Diagnosis of Torn Semilunar Cartilage. E. G. Herzog. *Lancet* 2: 5-6, July 7, 1945.

In 12 cases of injury to the knee joint, a diagnosis could not be made by simple clinical means and air arthrography was carried out. A torn semilunar cartilage was diagnosed in 8 of these cases and excluded in 4. Operation or the subsequent history confirmed the findings in 10 instances.

The author's technic is as follows: The leg is prepared as for operation and the procedure is carried out under full aseptic conditions. A No. 20 needle is inserted into the suprapatellar pouch after injection of a little novocain. Any effusion is aspirated. Air, filtered through several layers of gauze, is injected with a 20 c.c. syringe fitted with a three-way tap. In the series reported the amount of air used varied between 60 and 120 c.c., depending upon the distention produced and the amount of pressure needed to push home the piston. A collodion dressing is applied and a bandage is used to compress the suprapatellar pouch and increase the amount of air in the joint. With the patient on his side, the line of the knee joint is marked under the fluoroscope. This is important because the beam must pass exactly along the joint line if overlapping in the film is to be avoided, and since this line by no means always runs at an exact right angle to the long axis of the limb, it cannot otherwise be estimated. With the tube horizontal and the central beam passing through the knee tangentially, three views are taken of the cartilage. The joint should be opened by abduction (adduction when the external cartilage is suspected) of the leg over a sandbag. If other joint lesions are suspected, the usual three views of the whole knee joint can be taken. A film showing the retropatellar space will disclose chondromalacia patellae if it is present.

No case of sepsis followed this procedure, and none of the patients complained of pain.

"Metastatic" Calcification in Soft Tissues of Legs in Osteitis Deformans: Case Report. Bernard Scigman and Lonis Nathanson. *Ann. Int. Med.* 23: 82-91, July 1945.

"Metastatic" calcification in the soft tissues has been reported in only one previous case of osteitis deformans

(Wells and Holley: *Arch. Path.* 34: 435, 1942). Metastatic calcification is to be distinguished from calcinosis. The former represents calcification of apparently healthy tissue due to changes in the composition of the blood calcium and phosphorus salts, phosphatase, or alkalinity. The latter represents another stage of an underlying pathologic process such as occurs in scleroderma, sclerodactyly, Raynaud's disease, etc.

The authors' patient had advanced Paget's disease of all the skeletal structures, demonstrable roentgenographically. The disease appeared to be most marked in the skull, pelvis, spine, and lower extremities. The skull, in particular, was tremendously enlarged, having a scaphocephalic configuration with considerable flattening. The maxillary, ethmoidal, and sphenoidal sinuses were obliterated by overgrowth of bone. The bones of the base of the skull were dense and eburnated, with similar alterations in the temporal bones. In addition to the advanced distortion of the pelvis due to Paget's disease, a flattening and deformity of the hips producing a coxa vara configuration were apparent.

The lower extremities, in addition to evidence of Paget's disease, showed extensive calcification of a granular and mottled type within the soft tissues. This was most pronounced in the subcutaneous tissue and extended through the muscle planes particularly along the mesial and posterior surfaces from below the level of the knee to above the ankle joint. The patient had had edema and venous stasis of the legs, due to heart failure, for eight years. There was no soft-tissue calcification in the upper extremities.

Moderately advanced calcification was present in the abdominal and pelvic vessels, but no calcification in the popliteal or tibial vessels at the level where the soft-tissue calcification was found. Several fractures of both lower extremities were seen, which healed normally. The soft-tissue calcification was apparently not related to the fractures. Minimal calcification was present in the thoracic aorta and mottled changes could be demonstrated through both lungs, many of which had a circumscribed appearance suggesting calcification within pulmonary vessels.

It is difficult to explain with the information at hand why calcification of the soft tissues of the body occurred in this case. In osteitis deformans a negative calcium and phosphorus balance is present in the earlier and more active form of the disease. A positive balance occurs in the later and less active stages, with blood calcium and phosphorus levels normal throughout. The serum phosphatase, however, is increased during the entire disease, sometimes to extremely high levels.

The authors stress the absence of chronic renal insufficiency which can be associated with the protracted presence of calcium and phosphorus ions in the blood in concentrations far in excess of those at which deposition of calcium phosphate may be expected theoretically. They believe that the edema of the lower extremities played an important etiologic role. The patient had received viosterol and calcium over a period of one and a half years, but no significance is attributed to this.

STEPHEN N. TAGER, M.D.

Tissue Calcification and Renal Failure Produced by Massive Dose Vitamin D Therapy of Arthritis. T. S. Danowski, A. W. Winkler, and J. P. Peters. *Ann. Int. Med.* 23: 22-29, July 1945.

Two cases of renal damage secondary to prolonged therapy with vitamin D are described in detail. In one

of these extensive calcification of soft tissues was readily demonstrable.

The first patient was a woman originally seen in 1932 for a painful deforming arthritis of the extremities, of eighteen years' duration. Laboratory studies at that time were within normal limits. Roentgen examination of the right wrist and hand and of the hips showed narrowing of the joint spaces with thinning of the adjacent bone but no generalized osteoporosis. From 1936 to May 1942 the patient received 150,000 to 200,000 units of vitamin D daily. In November 1942 she returned to the hospital with localized fluctuant swellings at the left wrist and right ankle. Laboratory studies now showed anemia and renal insufficiency. The findings included azotemia, urine of low specific gravity, albumin 2 plus, casts, decreased excretion of phenolsulphonphthalein, and a high serum calcium and phosphorus. Roentgenograms showed decalcification of all bones except the skull, narrowing or destruction of joint spaces, and extensive calcific deposits in the soft tissues of the hands, wrists, and right ankle. No calcification was demonstrable in the abdominal organs.

Two and a half years after cessation of vitamin D therapy, serum calcium and phosphorus values had returned to normal; the non-protein nitrogen of the blood was still high, but the urine was free of albumin and casts. Roentgenograms revealed a striking decrease or complete disappearance of calcium in the soft tissues of the hands, wrists, and ankle. In addition, complete destruction and absorption of some of the bones of the wrists were evident, together with concentric decrease in the head of the right femur and movement of the right acetabular surface upward.

The second patient was admitted for intermittent abdominal cramps, nausea, and vomiting, of three months' duration. On her physician's advice, she had been taking vitamin D for seven months for relief of arthritic pain. The initial daily dose of 50,000 units was increased in the course of eight weeks to 500,000 units, at which level it was maintained for five months, being discontinued two months before admission. Laboratory studies revealed hypochromic anemia, an elevated blood non-protein nitrogen content, urine of low specific gravity, and poor excretion of phenolsulphonphthalein dye. A distinct hypercalcemia existed, together with an increased concentration of serum phosphorus. The skull was osteoporotic; proliferations of bone were seen at the knee and hip joints, and on the vertebral bodies, of the type associated with hypertrophic osteoarthritis. There was no metastatic calcification. Repeated serum calcium and phosphorus determinations showed a gradual return to normal values during the next twelve weeks.

These two cases indicate that vitamin D in large doses provokes a hypercalcemia and increases the calcium content of the soft tissues, particularly of the kidney. The hypercalcemia favors metastatic calcification. This may be facilitated by local tissue injury already present, or produced by the vitamin D itself. Calcification in the kidney affords a satisfactory explanation of the renal damage even though, in the cases here recorded, the calcium deposits were too low in concentration to be demonstrated in roentgenograms. This impairment of renal function by vitamin D is to a considerable extent reversible.

The extensive destruction of bone evident in the wrists and right hip of the first patient is an anomalous development in the natural course of atrophic arthritis.

It suggests that the extensive intake of vitamin D together with a low intake of calcium and phosphorus produced disruption of the histology of the bone, of the type reported in rats, with subsequent absorption of the injured bone. During the first five of the six years of therapy this patient did not drink milk nor did she receive supplementary calcium.

No clear principle has been formulated for a rational use of vitamin D in arthritis. Clinical improvement reported during its administration is not correlated with any consistent alteration in the density of the skeleton or of exostoses. In serial roentgenograms the osteoporosis may increase, decrease, or remain unchanged. There is no evidence that improvement is related to the development of hypercalcemia. It seems clear, therefore, that the favorable effects reported are unrelated to the metabolism of calcium and phosphorus, which is not surprising in view of the repeated failure to demonstrate any definite abnormality in the calcium and phosphorus balance of patients with arthritis. That treatment with vitamin D demands careful supervision is obvious.

STEPHEN N. TAGER, M.D.

Fatigue Fracture of the Tibia. Three Cases at a Naval Training Establishment. Trevor P. Mann. *Lancet* 2: 8-10, July 7, 1945.

Three cases of fatigue fracture of the tibia in adolescent naval recruits were encountered in six weeks at a training establishment. The clinical and radiological findings suggest that the condition is a well defined entity. The author believes that the paucity of published cases in Great Britain during the war indicates that the condition is being overlooked in the Services.

Fatigue Fracture of Femur and Tibia. H. R. I. Wolfe and J. M. Robertson. *Lancet* 2: 11-13, July 7, 1945.

Two cases of fatigue fracture, one of the tibia and the other of the femur, are reported. These illustrate the occurrence of such lesions in healthy young adults undergoing intensive training and the need for thorough treatment.

Stress Fracture of Femoral Neck. John A. W. Bingham. *Lancet* 2: 13-14, July 7, 1945.

A case of stress fracture of the femoral neck is presented. This case differs from others so far reported in that there was a basal fracture of the neck of the femur with varus deformity, such as occurs typically in fractures due to gross violence. From cross-questioning of the patient it was learned that he had suffered no gross injury. Slight pain had come on immediately after a training exercise, becoming much worse a few days later. From the history it seems probable that the fracture had at first been a crack without displacement and that subsequently the fragments separated and became displaced, with increasing pain.

THE GENITO-URINARY SYSTEM

Renal Hypoplasia with Hydroureter and Primary Amenorrhea. Report of a Case. Frank M. Huff and William P. Boger, Jr. *J. Urol.* 54: 116-122, August 1945.

The authors call attention to the frequent association of genital and upper urinary tract anomalies, particu-

larly absence of one kidney in the presence of genital anomaly in the female. They differentiate between renal agenesis, aplasia, and hypoplasia, the important point being the complete absence of renal tissue in agenesis.

The case presented is that of a 26-year-old woman who complained of complete absence of menstruation, urinary frequency, and left upper abdominal distress radiating toward the bladder. Examination revealed a mass in the right upper quadrant, shown roentgenologically to be due to hyperplasia of the right kidney, and an indefinite mass in the left upper quadrant. Roentgenograms showed an absence of the left kidney shadow and there was no appearance of dye on the left in the excretory urogram.

Cystoscopy revealed a minute left ureteral orifice with a very small excretion of phthalein dye from that side. After dilatation of the ureteral meatus and passage of a No. 8F catheter, 75 c.c. of clear urine was obtained. Retrograde urography showed a greatly dilated and tortuous left ureter, but no renal pelvis could be demonstrated.

Investigation of the uterus by both hystorgraphy and curettement showed a very small uterine body with a rudimentary uterine cavity.

At operation a very small left kidney without calices was found. The ureter was extensively dilated and showed a stricture of the intramural portion. The left urinary tract was removed down to the bladder. Microscopically the kidney parenchyma was normal.

J. L. BOYER, M.D.

Primary Carcinoma of Ureter with Special Reference to Hydronephrosis. Review of Literature and Report of an Unusual Case. Joseph A. Lazarus and Morris S. Marks. *J. Urol.* 54: 140-157, August 1945.

The authors' patient was a woman of 41, referred to them because of an epigastric mass. Her chief complaints were precordial pain and palpitation and episodes of urinary frequency. About twelve years previously she had experienced an attack of pain in the urinary bladder, which recurred two years later and was diagnosed, after an incomplete urologic examination, as cystitis. After a ten-year period without symptoms dysuria again occurred, followed by what appeared to be an attack of coronary heart disease. It was during the course of cardiographic studies that the mass in the epigastrium was discovered. It was firm and non-tender and did not move with respiration.

Roentgenography showed outward dislocation of the lower pole of the left kidney and, medial to its inner border, a pear-shaped shadow parallel to the psoas margin. In the lateral view there was an indistinct shadow of a mass anterior and parallel to the lumbar spine. Excretory urography showed a normal right kidney but enormous enlargement of the left renal silhouette.

Operation disclosed a tumor of the left ureter, which proved histologically to be a transitional-cell carcinoma, with metastases in the renal peripelvic region. The ureter above and below the tumor was dilated and the kidney was converted to an enormous multilocular hydronephrotic sac which had been pressing on the heart through the diaphragm and possibly irritating the vagus nerve and solar plexus, producing the cardiac symptoms of which the patient complained.

There follows an excellent discussion of primary tumors of the ureter, especially those which take origin from the ureteral mucosa. The authors consider their

classification, incidence, and symptoms. They state that, while pain, hematuria, and an enlargement of the kidney are supposed to constitute a characteristic triad of symptoms in these cases, the diagnosis cannot be made on this basis but requires carefully executed and correctly interpreted roentgen and cystoscopic studies. In their opinion, a clear-cut and persistent filling defect in the ureterogram, especially when associated with ectasia of the segment of ureter just above, constitutes the only pathognomonic sign of ureteral tumor. The chances of demonstrating such a defect would be enhanced if repeated attempts were made to obtain good ureterograms in all cases with evidence of ureteral obstruction, bleeding through the ureteral catheter as a result of manipulation at the site of obstruction, and failure to show a calculus at the point of obstruction. The treatment of choice is complete extraperitoneal nephroureterectomy.

N. P. SALNER, M.D.

Vaso-Seminal Vesiculography and Its Clinical Application. Arne Bertelsen and H. H. Wandall. *Acta radiol.* 26: 36-45, Jan. 22, 1945.

Roentgen examination of the male genitals as performed by the authors was conducted by exposing the vas immediately proximal to the testis through a small scrotal incision and injecting 3 to 5 c.c. of perabrodil into the lumen through a small hypodermic needle. The contrast material may be injected by the transurethral approach into the ejaculatory duct.

Sixteen examinations are reported, 6 in the course of sterilization procedures on account of imbecility and 10 in patients with disease of the genital system. The seminal vesicles were found to be quite variable, from a simple canal to a dilated structure containing diverticulum-like expansions. The junction of the vas and ejaculatory duct was always distinct. In 4 persons the canals united to form a single ejaculatory duct, and in 2 there were separate ducts on each side, opening side by side into the urethra. Obstruction was readily diagnosed, but inflammatory changes were hard to diagnose because they cause so slight an alteration and the normal is so variable. The procedure is safe and is indicated in patients with aspermia and with seminal vesiculitis, in adults about to undergo orchidopexy, and in patients with pain in the groin following herniotomy.

LEWIS G. JACOBS, M.D.

Some Practical Hints on the Performance of Urography on Infants. Harald Christiansen. *Acta radiol.* 26: 46-48, Jan. 22, 1945. (In English.)

In infants, the more or less elaborate preparations for urography employed in adults are impractical. Copious defecation and fasting for three or four hours before examination are sufficient. Although intravenous administration of the medium is best, the cubital veins are seldom accessible, and it is too dangerous to use the fontanelle, as an accidental subdural injection may be fatal. The superior temporal vein and its branches are the best to use, the contrast substance being introduced with a fine needle. If the intravenous route is impractical, intraosseous injection is recommended, a sternal cannula being inserted into the anteromedial face of the tibia. Gas in the bowel is displaced by distending the stomach with 50 c.c. of apollinaris sweetened with saccharine; the kidneys are then seen through the stomach shadow. A roentgenogram illustrating this effect is reproduced.

LEWIS G. JACOBS, M.D.

TECHNIC

Protection in Roentgenoscopy. John F. Bacon and Eugene T. Leddy. *M. Clin. North America* 29: 1036-1041, July 1945.

In a study of 135 physicians who came to the Mayo Clinic between 1919 and 1935 for advice about or treatment of roentgen-ray injury, it was found that 91 had contracted their injuries during reduction of fractures with the fluoroscope. Of this number, 78 admitted the use of no protection and 11 began to use lead rubber gloves only after injury became apparent. Of the 135, only 8 had had any roentgenologic training, and these 8 had all failed to follow the recommended measures of protection until they had been injured.

The inexperienced or careless operator may exceed the limits of safety to himself by (1) lack of proper technic of examination; (2) excessive "puttering around"; (3) incomplete adaptation of the eyes to darkness; (4) too much current and voltage; (5) insufficient filtration in the roentgenologic apparatus; (6) use of too large fields; (7) placing the bare hand in the field; (8) lack of lead rubber protecting gloves; (9) inattention to the time that the roentgen tube has been in operation; and (10) ignorance of the protecting devices advocated by the Safety Committee.

The observation of the following rather simple rules will reduce the number of injuries markedly: (1) Know the output of the machine and the time it takes the machine in operation to reach an output which represents the limit of safety to the skin. Calibration of the tube in r per minute is essential. (2) Use an aluminum filter at least 1 mm. thick. (3) Determine the lowest intensity of rays which allows satisfactory visualization. (4) Be certain of thorough "dark adaptation" of the eyes. (5) Wear lead rubber gloves and carry out manipulations with the hands outside the beam as much as possible. (6) Use roentgenograms instead of the roentgenoscope.

Training, common sense, and experience are probably the three most important protective devices with which the operator can fortify himself. Carelessness and ignorance are the most common causes of injury from irradiation.

Roentgen Cinematography as a Routine Method. Bengt S. Holmgren. *Acta radiol.* 26: 286-292, March 31, 1945. (In English.)

The advantages and disadvantages of modern roentgen cinematography, as described by Holm (*Acta radiol.* 25: 163, 1944. *Abst. in Radiology* 46: 531, 1946) are discussed. Emphasis is laid on the value of the method for the study of deglutition and examination of the esophagus. The advantages of cinematography in arteriography and venography are also set forth.

The author considers the cinematographic method of particular value for teaching, as it eliminates crowding about the fluoroscopic screen, does away with unnecessary examinations, and makes available a wider range of material than is likely to be represented in the hospital at any one time. F. ELLINGER, M.D.

Results of Micro-Radiography. F. Bohatyrtshuk. *Acta radiol.* 25: 351-365, Sept. 20, 1944. (In German.)

In spite of the fact that microradiography has been employed for over thirty years, the method is still little known and has failed to obtain general acceptance. The necessity, or at least advisability, of special x-ray tubes, extremely delicate photographic emulsions, and other technical difficulties have resulted in only rare investigations and references in the medical literature. Microscopic sections, 20 to 50 micra thick, are used, usually with a contrast medium. While x-ray exposures of 5 kv. and 100 ma. may be employed, more frequently exposures of 10 to 15 ma. and 6 to 10 minutes are the rule. The most common microscopic magnifications vary from 10 to 60 times. However, by means of fine granulation emulsions, radiography of magnifications up to 600 or even 800 times is possible, necessitating exposures of 30 to 40 minutes (at 15 ma.). Bohatyrtshuk's work is especially concerned with the visualization and study of the capillaries. The technical factors of the method are described in detail, including the preparation of the emulsion. A number of microroentgenograms are produced.

ERNST A. SCHMIDT, M.D.

RADIOTHERAPY

Treatment of Hemangiomas with Roentgen Rays. James V. Prouty. *Am. J. Roentgenol.* 54: 172-177, August 1945.

The use of unfiltered roentgen rays in the treatment of hemangiomas is described. For all flat lesions and for thick lesions with a diameter greater than 3.0 cm., rays produced at 80 kv. are used, with a target-skin distance of 15 cm. For all lesions thicker than 0.5 cm. and with a diameter less than 3.0 cm., 135-kv. radiation is employed at 18.0 cm. distance. The lesion is shielded with lead foil, and from 300 to 600 r are given at one treatment, depending upon size and location. The larger doses are used in lesions of a centimeter or less in diameter. An occasional mild erythema occurs along the edge of the lesion with these larger doses, but otherwise no reactions have occurred. Treatment is repeated in one month if there is no response and no erythema. If the lesion shows response to the first treatment, two months are allowed to elapse before continuing treatment. Great care should be

taken in the treatment of lesions near epiphyses and glandular structures. In 129 cases treated from December 1939 to January 1944, the results were classified as follows: excellent, 87; good, 27; fair, 8; poor, 4.

L. W. PAUL, M.D.

Slowly Developing Non-Pigmented Nevo-Epithelioma Presenting a Non-Characteristic Histologic Picture. Jens Munck Nordentoft. *Acta radiol.* 26: 155-162, Jan. 22, 1945. (In French.)

Report of a case of non-pigmented nevo-epithelioma with multiple metastases. Some palliation was obtained from roentgen therapy and the patient survived five years, an unusually long course.

Roentgen Treatment of Malignant Tumors of the Nasopharynx. Jens Nielsen. *Acta radiol.* 26: 133-154, Jan. 22, 1945. (In English.)

The author discusses the clinical and pathological aspects of nasopharyngeal tumors and describes 37

cases treated by the Coutard method (180-200 kv., 4-6 ma., Thoraeus filter, 50-70 cm. F.S.D., 2 1/2-7 1/2 r/min., and usually 2 daily treatments). The dose per treatment was 75 to 200 r; total dose, 3,300 to 10,000 r. Five years later 9 of the group were apparently cured, 2 were alive with recurrence, and 26 dead. Patients with sarcoma did somewhat better; no patient with a highly differentiated carcinoma was cured. Even in cases with invasion of the base of the skull, considerable palliation was obtained. LEWIS G. JACOBS, M.D.

Skeletal Metastases in Cancer of the Breast: Study of the Character, Incidence and Response to Roentgen Therapy. Jean Bouchard. *Am. J. Roentgenol.* 54: 156-171, August 1945.

A study of skeletal metastases from cancer of the breast is presented, based on 37 cases seen since 1938 with 24 of the patients having died up to the present time; 87.5 per cent of the cases belonged to clinical Groups II and III and bone metastases seldom occurred unless there had been invasion of the axillary lymph nodes. Skeletal lesions were the only metastases demonstrable in 62.5 per cent of the group. The age factor did not seem of any significance in determining the incidence or degree of malignancy of the metastases. Three general types of roentgenographic change are described: (1) the osteolytic type, observed in 75 per cent of the cases; (2) the osteoblastic type, in 8.3 per cent; (3) the osteolytic-osteoblastic type, in 16.7 per cent. All three types may be seen in the same patient at some time during the course of the disease.

Under roentgen therapy, 66 per cent of the series showed subjective improvement, with 26 per cent also showing an objective response to irradiation. The average survival for this latter group was 18 months while it was 13.6 months for the group as a whole.

L. W. PAUL, M.D.

Carcinoma of the Uterine Cervix: Interval Report on Treatment, Results, and Complications. George Van S. Smith and R. Dresser. *Am. J. Obst. & Gynec.* 50: 1-10, July 1945.

This report covers a series of 1,111 cases of cervical cancer treated between 1902 and 1938, inclusive. The authors have divided their cases into groups, because of changes in type of treatment from time to time.

In the first group are 83 cases seen between 1902 and 1913. Of these, 8 were untreated; 37 were treated by cauterization; 6 by amputation of the cervix; 32 by hysterectomy. Despite the fact that the treatment of many of these patients was inadequate, 10 (12 per cent) were alive at five years and 6 (7 per cent) at ten years.

The group seen between 1914 and 1918 numbered 78 patients. Nine were untreated; 28 were treated by hysterectomy; 11 by hysterectomy and postoperative radium; ten by radium followed by hysterectomy; 23 by radium alone. There was a distinct improvement in the results, with 15 patients (19 per cent) alive at five years and 9 (11 per cent) at ten years.

In the next group of 119 cases seen between 1919 and 1923, 5 were untreated; 18 had hysterectomy; 15 hysterectomy with radium preoperatively or postoperatively; 81 radium therapy alone. At five years, 27 (23 per cent) were alive, and at ten years, 14 (12 per cent) were alive.

In the next period, 1924 to 1928, 226 patients were seen, of whom 7 were untreated; 1 had amputation of

the cervix and radium; 24 had hysterectomy; 8 hysterectomy and radium; 186 radium alone. Of this group, 64 (28 per cent) survived five years and 48 (21 per cent) survived ten years. The improved results here are attributed to the use of a single rather massive dose of radium, 200 to 225 mg. being used for twenty-four to thirty hours. However, a total of 6,000 mg. hr. was not exceeded.

Two hundred and seventy-six patients were seen between 1929 and 1933, of whom 5 were untreated; 1 had amputation of the cervix; 2 amputation of the cervix and radiation; 1 hysterectomy; 5 hysterectomy and radiation preoperatively or postoperatively; 109 radium alone, 153 radium and 200-kv. roentgen irradiation. The roentgen radiation was given in four treatments of 400 r each, immediately following the first application of radium. This was repeated in about two months and in some cases a third and sometimes a fourth series was given, six to twelve months later. The results in this group showed 106 (38 per cent) patients alive at five years and 84 (29 per cent) at ten years.

In the last group, 328 cases seen between 1934 and 1938, 12 were untreated; 1 had amputation of the cervix; 1 amputation of the cervix, with radium and x-ray therapy; 5 hysterectomy; 3 hysterectomy and radium; 3 hysterectomy and x-ray; 16 radium, x-ray, and hysterectomy; 32 radium alone; 191 radium and 200-kv. x-ray therapy by the previously outlined method; 41 radium and 200-kv. x-ray therapy with a newer method, and 23 radium and 1,000-kv. x-ray therapy. The results in this group showed 142 (43 per cent) alive at five years. The newer method of 200-kv. roentgen therapy used an average of five treatments through each of three portals, one anterior and two posterior, with an average total dose of 6,000 r measured with scattering. The 1,000-kv. radiation was delivered through three 10 X 10-cm. portals, one anterior and two posterior, for an average total of 7,500 r measured with scattering.

There is a consistent improvement in the five- and ten-year survivals over the years. This is most evident in the number of survivals in early cases. In the more advanced cases, there was some reduction in the number of survivals because of reduction in the amount of roentgen radiation given from fear of complications.

It is interesting to note that over 5 per cent of all the patients had supravaginal hysterectomy prior to the development of cervical cancer and that an additional 3 per cent had had operative procedures on the tubes and ovaries.

The complications encountered as a result of radiation therapy are fully discussed. Proctitis, ileitis, cystitis, rectovaginal and vesicovaginal fistulas, ureteral stricture, ureteritis, and pyelonephritis were the most common complications. The fistulas undoubtedly are the most distressing to the patients, whereas the ureteral strictures are the most serious so far as survival is concerned.

The authors believe that over-treatment in many of their cases accounts for the number of complications that they observed. They now consider anything over 5,400 mg. hr. of radium given in one application or 6,000 mg. hr. in two applications as an over-dose. They feel that the maximum relatively safe amount of 200-kv. roentgen radiation, when combined with the above dose of radium, is 6,000 r (with scattering). The relatively safe dose with 1,000 kv. may be as high as

7,200 r (with scattering). It is their impression that it is best to give all radiation within six weeks and to have the x-ray therapy precede the radium therapy except in cases with hemorrhage, which is more easily controlled by radium. The second most frequent cause for complications is mistaking irradiation reactions for recurrence and giving further treatment. Since retreatment is only occasionally efficacious, and that in questionable cases, it is safer to withhold additional therapy unless evidence of recurrence is convincing.

During irradiation, the authors give vitamin therapy in large doses, including thiamine chloride. Acute post-irradiation pelvic inflammations are best treated by repeated transfusions and bed rest. Rectal strictures are gently dilated, and an attempt is made to maintain soft stools. Instillations of cod-liver oil are used for irradiation cystitis and transfusions and bed rest for severe hematuria. Vesicovaginal fistula has been successfully treated by colpocleisis. Rectovaginal fistula is most satisfactorily handled by colostomy, though this is refused by many patients. Urethral stricture is often accompanied by cystitis, making it difficult to catheterize the ureters. The procedure of choice, *i.e.* sacrifice of the kidney or reimplantation of the ureter, will depend upon the individual case.

The authors conclude that x-ray and radium therapy are far superior to surgery so far as end-results are concerned, though surgery is required for radioresistant cancers.

BERNARD S. KALAYJIAN, M.D.

Radiation Therapy in Uterine Fibroids. John Day Peake. *South. M. J.* 38: 480-484, July 1945.

This report is based on a series of 300 patients with uterine fibroids referred for radiation therapy over a period of ten years; 290 were treated. In the majority of cases the predominant symptom was abnormal bleeding. Frequently when this had been controlled by irradiation the tumor showed a considerable decrease in size.

Before instituting radiotherapy, the diagnosis must be assured. Cancer and pregnancy must be ruled out, and one must be sure that there are no pelvic or abdominal complications which will be aggravated by radiation.

Most of the author's patients were over forty years of age, but younger women may be treated by radiation if future childbearing is not a consideration. In several instances in this series irradiation was chosen rather than surgery because of concomitant extra-abdominal disease.

It has frequently been stated that severe menopausal shock follows irradiation. In the author's experience, however, menopausal symptoms are not more severe than after surgery. In several of his younger patients the menstrual cycle was re-established. He encountered no instance of loss of libido, but in no case did pregnancy follow treatment.

The choice of treatment in any given case is governed by many factors. If the diagnosis is unquestioned, and there are no pelvic complications, it is usually safe to use external irradiation alone. If dilatation and curettage are required to rule out other disease, radium within the uterine cavity is preferred. For external irradiation the factors were the conventional ones: 200 kv.p., 20 ma., 50 cm., 6 mm. Al and 0.5 mm. Cu, half-value layer Cu 0.9 mm., 15 cm. port. An anterior

and a posterior port were used, except in the presence of large tumors, when a second anterior port was added; 250 to 300 r were given daily to one area, the patient being treated six to twelve times, usually within two weeks. For radium therapy, 35 to 50 mg. were implanted in the uterus with 1.0 mm. platinum filtration. The total dose was 800 to 3,000 mg. hr. When both roentgen rays and radium were employed (in patients who failed to respond to roentgen therapy alone) the radium dose was smaller than in patients previously untreated.

Of the present series, 186 were treated by roentgen irradiation alone, 86 by radium, and 18 by both. In only 2 cases was there failure to relieve the uterine hemorrhage. In one of these a submucous pedunculated fibroid was discovered at subsequent hysterectomy; the other patient had a complicating tubo-ovarian abscess. In 10 cases bleeding recurred after administration of stilbestrol, but ceased when the drug was withheld. In one case theelin caused a return of bleeding. No deaths or complications followed irradiation in this group of 290 cases, and subsequent operation did not appear to be made more difficult.

In the discussion of this paper Dr. R. T. Wilson stated that he had found as much as 3,000 to 4,000 r necessary in the treatment of uterine fibroids. Dr. Edwin C. Ernst emphasized the eminently satisfactory results obtained by fractional roentgen therapy. His observations covered a twenty-five-year experience.

A statistical tabulation of the author's cases would have been a valuable addition to an otherwise excellent paper.

MAX MASS, M.D.

Studies in Hodgkin's Syndrome. IV. The Therapeutic Use of Radioactive Phosphorus. Herman A. Hoster and Charles A. Doan. *J. Lab. & Clin. Med.* 30: 678-683, August 1945.

The results of radioactive phosphorus therapy in 11 cases of proved Hodgkin's disease are reported. Five of the patients in this series had had previous x-ray therapy. Each biweekly dose of P^{32} was determined as a function of the tolerance of the individual patient, measured in terms of abrupt thrombocytopenia or by other less acute evidences of bone marrow hypoplasia. This treatment was discontinued and other measures substituted in every case when an increase in the activity of the disease was indicated by additional lymphadenopathy or roentgen evidence of bone involvement.

In the majority of the 11 patients, a fall in the hematocrit reading, in the hemoglobin level, and in total red blood cells, platelets, and total white blood cells, including lymphocytes and monocytes, was recorded during radioactive phosphorus therapy. The average bi-weekly intravenous dose was 23.1 millicuries, the minimum 1.26 millicuries, maximum 3.01 millicuries. In 10 of the 11 patients additional adenopathy or demonstrable evidence of bone involvement developed during the course of therapy. The maximum and minimum periods during which treatment was carried out before further activity developed were thirty-seven weeks and ten weeks, respectively. One patient did not return for treatment after the eleventh week, and one patient died during therapy. Eight of the 9 patients who received roentgen irradiation after cessation of phosphorus isotope therapy responded favorably to the former.

The authors conclude that radioactive phosphorus in these cases of Hodgkin's disease in the dosage and under

the conditions described did not prove of therapeutic value. Depression of hemocytopenia, with special emphasis on thrombocytopenia, was noticed.

Treatment of Leukemia with Artificial Radio-active Sodium: Preliminary Report. Jørgen E. Thygesen, Aage Videbæk, and Irgens Villume. *Acta radiol.* 25: 305-316, Sept. 20, 1944. (In English.)

The authors investigated the effect of radiosodium (Na^{24}) in 7 cases of chronic lymphatic leukemia and in a case of polycythemia vera. The radioactive isotope of sodium was furnished by Profs. Niels Bohr and J. C. Jacobsen of the University of Copenhagen. Radiosodium is easier to produce than radioactive phosphorus and is distinguished from other usually employed radioactive isotopes in several respects. Unlike radioactive phosphorus (P^{32}), which is a pure beta-ray emitter with a half-life of 14.3 days, radiosodium emits not only beta rays but also very hard gamma rays (even harder than those of radium). Its half-life is only 14.8 hours. While other radioactive isotopes more or less accumulate in certain organs, e.g. in bones or lymphatic tissue, radiosodium is found almost exclusively in the extra- and intra-cellular fluid. Unlike radiophosphorus, it maintains an almost constant level in the blood stream. Its distribution and radiation are much more diffuse in the body than those of other radioactive substances. Excretion is slow and takes place through the urine.

The single doses in the cases treated varied from 2 to 36 millicuries, injected intravenously in 20 c.c. of physiologic NaCl solution. The total dose ranged from 6 to 178 millicuries, given in 1 to 12 injections with a usual interval of about 48 hours. In two cases (not tabulated in the article) radioactive sodium chloride was administered orally in milk or soda water.

Untoward symptoms were rare and mild; they were represented by slight diarrhea, hot flashes, slight fever, and, in one case of oral administration, by nausea and vomiting. Except in one case which later also proved resistant to x-ray radiation, the injections were followed by a considerable fall in the leukocyte count (in one case from 95,000 to 21,000 within four days). There was no significant change in the erythrocyte count, the hemoglobin percentage, or the sedimentation rate. The general condition of the patients improved during the treatment both subjectively and objectively. The relatively short period of observation (maximum about 150 days) and the limited number of cases preclude definite judgment as to the final value of the treatment, although the apparently favorable results encourage further trials. In the case of polycythemia vera, the effects were inconclusive and transitory.

ERNST A. SCHMIDT, M.D.

DOSAGE

Dosis Measurements in Roentgen Irradiation of Female Pelvis: Preliminary Communications. Anton Jensen. *Acta radiol.* 26: 99-116, Jan. 22, 1945. (In English.)

The author made phantom studies of depth dose in

the female pelvis both with standard technique and rotation technic. He found that an eccentric, rotating pair of fields which make an arc of 104° from above laterally on each side gives the optimum depth dose.

LEWIS G. JACOBS, M.D.

Determination of the Dose in Circular Phantoms under Rotatory Irradiation. Howard Nielsen. *Acta radiol.* 25: 183-194, June 30, 1944. (In English.)

The author's studies cover the amount of the surface dose and the dose in the center of the rotation—the axis dose, or center dose—at a given output with rotatory irradiation and circular phantoms. Also, the dependence of these values on the diameter of the phantom, size of the field, radiation quality, and divergence of rays (target-center distance) are studied.

The results were recorded graphically in three curves for each phantom. These curves give (1) the dose measured on the surface, recorded in percentage of output, (2) the dose measured in the center, converted to percentage of the output, and (3) the proportion between the center dose and the surface dose. The term efficiency coefficient (EC) was adopted for the ratio between the center dose and the surface dose.

The curves show that, using rotatory irradiation, the most favorable conditions are obtained with a narrow axis field, medium-sized phantom radius, hard rays, and great target-center distance. In practice, the radius (cross section of the body) is given and the axis field determined by the extension of the tumor, so that changes in the conditions are limited to the target-center distance and the radiation quality.

Dose distribution curves for different axis fields are given. The values measured for the dose in the center are considerably higher than calculated, and the difference between the measured and calculated dose distribution curve is mentioned. Because of such differences, the author advises care in the use of rotatory irradiation, as the risk of over-dosage is far greater than in ordinary roentgen treatment.

JOSEPH H. WEISS, M.D.

A Simple Device for the Continuous Control of Roentgen-Ray Output. Sv. Hoeffter Jensen. *Acta radiol.* 25: 224-226, June 30, 1944. (In English.)

An essential feature of roentgen therapy is the constancy of output of the roentgen tube. Such constancy is generally assured by measurements of intensity made from time to time, and it is then assumed that if consecutive measurements do not differ from each other, the output has been the same during the intermediate period.

Intensity may vary sufficiently to be of clinical importance according to the author. He has designed an instrument to measure the total flux of roentgen rays. It consists of two parts: (1) ionization chamber and (2) amplifier.

Diagrams are given illustrating the installation of the ionization chamber on the tube and the amplifier circuit. This apparatus makes possible simple and continuous control of the roentgen output.

JOSEPH H. WEISS, M.D.

INDEX TO VOLUME 46

A

- AARON, A. H.:** Inflammatory lesions of the upper gastrointestinal tract (ab), March, 295
- ABDOMEN**
- arteriography in renal and abdominal conditions (ab), O. A. Nelson, Feb., 205
 - roentgenography
 - advantages of supplemental studies at time of [army] induction (ab), A. C. Galluccio, Jan., 89
 - calcified appendices epiploicae as freely mobile bodies in abdominal cavity (a roentgenographically interesting subsidiary find) (ab), Olallo Morales, April, 429
 - tumors
 - lymphangioma: unusual case (ab), C. F. Murbach, E. F. Lewison, and G. A. Deibert, May, 538
 - wounds and injuries
 - radiology of wnr injuries. Part I. Wnr wounds of abdomen, D. B. McGrigor and Eric Samuel, Feb., 201
- ABNORMALITIES.** See under various organs
- ABRODIL.** See Spinal Canal Roentgenography
- ACHONDROPLASIA**
- chondrodystrophia congenita calcificans; case (ab), Sigvard Jorup, April, 434
 - identical twins: achondroplastic dwarfs (ab), S. J. Goodman, April, 435
- ACKERMAN, LAUREN V., WILEY, H. M., and LeMONE, DAVID V.:** Necrotizing bronchopneumonia: its relation to radiation therapy of cancer of the oral cavity (ab), Jan., 103
- ACROCEPHALY**
- true oxycephaly with syndactylism. Case report (ab), Bernard N. E. Cohn, March, 294
- ACROMEGALY**
- joint disease associated with acromegaly (ab), H. Waine, G. A. Bennett, and W. Bauer, March, 305
- ACTA RADIOLOGICA** (ed.), Leo G. Rigler, April, 411
- ADAIR, FRANK E., TREVES, NORMAN, FARROW, JOSEPH H., and SCHARNAGEL, ISABEL M.:** Clinical effects of surgical and x-ray castration in mammary cancer (ab), March, 312
- ADAMS, RALPH, and HOOVER, WALTER B.:** Benign tumors of the esophagus. Report of three cases (ab), June, 616
- ADAMS, WILLIAM E.** See BLOCH, ROBERT G.
- ADAMSON, J. D., WARNER, W. P., KEEVIL, R. F., and BEAMISH, R. E.:** Tuberculosis in the Canadian army 1939 to 1944 (ab), Jan., 89
- ADENOFIBROMA.** See Tumors, fibroadenoma
- ADOLESCENCE**
- conservative management of adolescent slipping of capital femoral epiphysis (ab), Robert D. Moore, Jan., 99
 - effect of severe rickets in early childhood on skeletal development in adolescence (ab), Ethel C. Dunham and Herbert Thoms, May, 539
 - skull defect and herniation of cerebrum with absence of dura following head injury in adolescence (ab), Wm. S. McCune and Barnes Woodhall, Feb., 193
- ADRENALS**
- tumors
 - hormonal tumors (ab), George F. Cahill, Jan., 95
- AEROSINUSITIS.** See Sinuses, Paranasal
- AGE**
- roentgenographic observations in age atrophy and osteoporosis of the spine, Gottlieb J. Marum, March, 220
- AGGLUTININS**
- cold isohemagglutinins: their association with hemolytic anemia and multiple thromboses in primary atypical pneumonia. Brief review of the clinical and laboratory problems involved (ab), William R. Platt and Charles S. Ward, Jr., March, 294
- AHLBOM, HUGO:** Case of polymyositis treated with roentgen rays (ab), March, 316
- AKENHEAD, WALTON R.** See MCCARTHY, PAUL V.
- AKERLUND, ÅKE, and WELIN, SÖLVE:** Roentgen diagnosis of malignant tumors within the boundary region between the pharynx and esophagus (ab), April, 422
- ALBRIGHT'S SYNDROME.** See Bones, diseases
- ALIMENTARY TRACT.** See Digestive System
- ALLEN, HARRY, HEMPELMANN, L. H., Jr., and WOMACK, NATHAN A.:** Effect of insoluble radiophosphorus (chromium phosphate) when applied interstitially in the treatment of adenocarcinoma of the mamma in mice (ab), March, 318
- ALLEN, WILLIAM E.:** Fatigue fracture of the metatarsal. Report of case, March, 276
- ALLEY, F. H.:** Extrapleural pneumothorax in the treatment of pulmonary tuberculosis. Three-year to five-year follow-up of 48 cases, May, 470
- AMEBIASIS**
- roentgenological manifestations of amebiasis of large intestine (ab), A. Druckmann and S. Schorr, June, 618
- AMENORRHEA**
- renal hypoplasia with hydroureter and primary amenorrhea. Report of case (ab), Frank M. Huff and William P. Boger, Jr., June, 625

AMERICAN BOARD OF RADIOLOGY

- examinations, May, 623
- ANDERSEN, SIGURD R.:** Malignancy of giant cell tumors: study on giant cell tumors and allied affections in bone, with reference specially to their malignancy (ab), June, 620
- ANEMIA**
- hemolytic
 - cold isohemagglutinins: their association with hemolytic anemia and multiple thromboses in primary atypical pneumonia. Brief review of clinical and laboratory problems involved (ab), William R. Platt and Charles S. Ward, Jr., March, 294
- ANEMIA, PERNICIOUS**
- gallbladder in patients with pernicious anemia: study of non-visualization and rate of emptying (ab), Edward A. Boyden and John A. Layne, Jan., 94
 - localization of gastritis and gastric cancer, especially in cases of pernicious anemia (ab), Johan Torgersen, March, 299
 - pernicious anemia and the early diagnosis of tumors of stomach (ab), Leo G. Rigler, Henry S. Kaplan, and Daniel L. Fink, April, 427
- ANESTHESIA**
- roentgenologic examination of stomach with patient under sodium pentothal anesthesia (ab), H. E. Plenge and J. N. Ross, Jan., 94
- ANEURYSM**
- arteriography for demonstration of intracranial aneurysms (ab), Robert M. Lowman and Simon D. Doff, Feb., 204
- aortic**
- value of kymography for differential diagnosis between aneurysm of aorta and mediastinal tumor (ab), Bryan Fabricius, June, 615
- pulmonary**
- multiple congenital arteriovenous aneurysms in pulmonary circulation (ab), John H. Sisson, George E. Murphy, and Elliot V. Newman, Jan., 92
 - peripheral aneurysm (ab), Arne Clausen, Feb., 205
- renal**
- aneurysm of renal artery (ab), Bernard Levine, May, 542
- ANGIOGRAPHY.** See Brain
- ANKLE**
- roentgenography
 - third routine exposure (ab), R. S. Simon, May, 541
- ANUS**
- congenital malformations of anus and rectum: clinical study (ab), Eugene T. Dmytryk, March, 300
- AORTA**
- abnormalities
 - chronic stridor in early life due to persistent right aortic arch: report of 2 cases (ab), Harold K. Faber, John W. Hope, and Francis L. Robinson, Jan., 92
 - aneurysm. See Aneurysm, aortic
 - calcification
 - significance of calcification in ascending aorta as observed roentgenologically (ab), James Jackman and Mortimer Lubert, March, 310
- AORTIC VALVE**
- dextrocardia with situs inversus complicated by chronic rheumatic aortic and mitral endocarditis (ab), George W. Parson, June, 616
- APPARATUS.** See Roentgen Rays, apparatus
- AQUEDUCT OF SYLVIVUS.** See Brain
- ARACHNODACTYLIA**
- arachnodactyly (spider fingers) (ab), H. Gray, Feb., 203
- ARANA, ROMAN, and ASENJO, A.:** Ventricleographic diagnosis of cysticercosis of the posterior fossa (ab), March, 293
- ARENDT, JULIAN:** Chronic hypertrophic antrum gastritis (ab), June, 617
- Significance of Cannon's point in normal and abnormal functions of the colon (ab), June, 618
- ARMS.** See Extremities
- ARNELL, SIGFRID:** Further experience with myelography with abrodil (ab), March, 303
- ARTERIES**
- pulmonary
 - method of determining blood pressure in pulmonary artery (ab), Nils Westermarck, Feb., 205
- roentgenography**
- See also Aneurysm
 - arteriography in renal and abdominal conditions (ab), O. A. Nelson, Feb., 205
 - pathological-anatomical basis of tumor arteriography. Investigation of arterial vessels of hypernephromas and carcinomas of stomach (ab), Lars Billing and Åke G. H. Lindgren, March, 311
- ARTHRITIS**
- See also Shoulder; Spine; etc.
 - roentgen therapy of arthritides (ab), Ira I. Kaplan, May, 546
 - tissue calcification and renal failure produced by massive dose vitamin D therapy of arthritis (ab), T. S. Danowski, A. W. Winkler, and J. P. Peters, June, 624

- ARTHROGRAPHY.** See Jaws; Semilunar Cartilages
- ASENJO, A.** See **ARANA, ROMAN**
- ASPRAY, MELVIN:** Calcified hemangiomas of the liver (ab), March, 301
- ATLAS AND AXIS fractures**
—fracture: review and presentation of data on 8 cases (ab), John J. Hinchey and William H. Bickel, April, 422
- ATLEE, Z. J.** See **VICTOREEN, J. A.**
- ATOMIC POWER.** See Radioactivity
- AUB, JOSEPH C.** See **ROBBINS, LAURENCE L.**
- AVIATION AND AVIATORS**
—aerosinusitis (ab), R. Wesley Wright and Harold M. E. Boyd, Feb., 193
—aerosinusitis: a clinico-roentgenological study (ab), Martin Schneider, April, 422
—aerosinusitis—a résumé (ab), Paul A. Campbell, Jan., 87
—experiences with photoroentgen method in chest surveys: analysis of 150,000 examinations (ab), Archie Fine and T. B. Steinbausen, June, 612
—parachute fractures (ab), Paul A. Knepper, May, 541
- AXEN, OLIVER, and LIND, JOHN:** Roentgenologic determination of heart volume in infants. Preliminary report (ab), April, 426

B

- BACHMAN, ARNOLD L.:** Roentgen diagnosis of knee-joint effusion, May, 462
- and **BERSHON, ALBERT L.:** Roentgenographic appearance of temporomandibular hydrarthrosis, March, 251
- , **SARA, NATHAN O., and MANTZ, HARRY E.:** Pleuritic involvement associated with primary atypical pneumonia: roentgenographic and clinical study (ab), Jan., 90
- BACKACHE**
—low-back pain as presenting symptom of malignant breast tumors (ab), T. D. Cohn and H. Cohn, Jan., 98
- BACON, JOHN F., and LEDDY, EUGENE T.:** Protection in roentgenoscopy (ab), June, 627
- BACTERIA**
—action of neutrons on bacteria (ab), F. G. Spear, March, 318
- BAGLEY, E. C.** See **BAGLEY, W. R.**
- BAGLEY, W. R., and BAGLEY, E. C.:** Stenosis of the sigmoid in the newborn (ab), April, 429
- BAKER, D. R.** See **BONNET, WILLIAM L.**
- BARRE, H. J.** See **McLAUGHLIN, A. I. G.**
- BASS, H. E., and THOMPSON, G. D. CARLYLE:** Incidence of tuberculosis in Japanese-Americans: a study of a homogeneous racial group (ab), May, 532
- BAUER, DONALD def.:** Ebstein type of tricuspid insufficiency: roentgen studies in a case with sudden death at the age of twenty-seven (ab), June, 615
- BAUER, W.** See **WAINE, H.**
- BAYLIN, GEORGE J.:** Aberrant pancreatic tissue as roentgenologic problem (ab), Jan., 94
- See **RUFFIN, JULIAN M.**
- BEAMISH, R. E.** See **ADAMSON, J. D.**
- BECHTEREW'S DISEASE.** See Spine, arthritis
- BEECHAM, CLAYTON T., and MONTGOMERY, THADDEUS L.:** Organization and administration of a gynecologic tumor clinic, with certain observations concerning therapy (ab), March, 313
- BEHRENS, CHARLES F.:** Some roentgenologic considerations pertaining to upper extremity pain (ab), Feb., 209
- BEHRMAN, HOWARD T.** See **LEVIN, OSCAR L.**
- BEINHAUER, LAWRENCE G.** See **FREEDMAN, LESTER M. J.**
- BELL, JOSEPH C., HEUBLEIN, GILBERT W., and HAMMER, HOWARD J.:** Roentgen examination of the urinary tract with special reference to methods of examination and findings in individuals with testicular tumors (ab), April, 435
- BENNER, SVEN:** Defects in roentgen tubes demonstrated by gamma-ray photographs (ab), April, 439
- , **KJELLBERG, SVEN R., and SJÖSTRAND, TORNGY:** On the possibility of studying the function of the heart with the aid of roentgen-cinematography. Roentgen-cinematography combined with electric recordings of the resistance of the cardiac valves (ab), May, 536
- BENNETT, G. A.** See **WAINE, H.**
- BERIBERI**
—"beriberi heart" in tuberculous patient (ab), Jason E. Farber and D. K. Miller, Feb., 199
- BERSHON, ALBERT L.** See **BACHMAN, ARNOLD L.**
- BERTENSEN, ARNE, and WANDALL, H. H.:** Vaso-seminal vesiculography and its clinical application (ab), June, 626
- BESNIER-BOECK DISEASE.** See Sarcoidosis
- BEZOAR.** See Stomach, foreign bodies
- BICKEL, WILLIAM H.** See **HINCHEY, JOHN J.**
- BILE DUCTS**
—roentgenography
—cholangiograms in intrabepatic processes (ab), Paul Rudström, March, 301
- BILIARY TRACT**
See also Bile Ducts; Gallbladder; Liver
—fistula. See Fistula
- BILLING, LARS:** Technic of contrast examination of the sigmoid colon (ab), April, 428
- and **LINDGREN, AKE G. H.:** Pathological-anatomical basis of tumor arteriography. Investigation of the arterial vessels of hypernephromas and carcinomas of the stomach (ab), March, 311

- BINGHAM, JOHN A. W.:** Stress fracture of femoral neck, June, 625
- BJÖRCK, GUNNAR:** On the relationship between the heart volume and various physical factors (ab), June, 616
- BIOPSY**
—sclerosing sarcoma of bone (dangers of biopsy) (ab), James F. Brailsford, Feb., 201
- BISHOP, WILLIAM A.** See **MARBLE, HENRY C.**
- BLADDER**
—roentgen diagnosis of space-restricting processes in small pelvis (ab), Lennart Walldén, April, 430
—study of the ureters in bladder neck obstructions, Fay H. Squire and Herman L. Kretschmer, Jan., 32
- BLADDER cancer**
—discussion on radiotherapy of tumors of kidney and bladder (ab), Stanford Cade and F. G. Stebbing, March, 314
—relationship of epithelial buds to carcinoma of the pelvis of the kidney, ureter and bladder (ab), Albert E. Bothe, Jan., 104
- roentgenography**
—excretory cysto-urethrograms (ab), John W. Draper and Joseph G. Siceluff, Feb., 204
- BLAIR, L. G.** See **EDWARDS, PETER W.**
- BLAST.** See Explosions
- BLASTOMYCOSIS**
—tumor of lung due to *Cryptococcus histolyticus* (blastomycosis) (ab), B. A. Dormer, J. Friedlander, F. J. Wiles, and F. W. Simson, June, 613
- BLOCH, ROBERT G., ADAMS, WILLIAM E., THORNTON, THOMAS F., and BRYANT, J. EDMOND:** Difficulties in the differential diagnosis of bronchiogenic carcinoma (ab), Feb., 198
- BLÖNDAL, INGOLFUR:** Case of cystic tuberculosis in bone and joint (ab), June, 622
- BLOOD.** See Eosinophils; Erythrocytes; Hemopoietic System; etc.
- BLOOD PRESSURE**
—method for determining blood pressure in pulmonary artery (ab), Nils Westermark, Feb., 205
- BLOOD VESSELS**
See also Arteries; Veins
—production of growth by action of pituitary gland on vascular and hemopoietic systems: interrelationship between lungs and pituitary gland (ab), Robert C. Moehlig, June, 614
- BODNER, HENRY, and MOULDER, MAX K.:** An unusual horseshoe kidney: case report (ab), Jan., 101
- BODY**
—relationship between heart volume and various physical factors (ab), Gunnar Björck, June, 616
- BODY SECTION ROENTGENOGRAPHY**
—fluorescent screen laminagraph (ab), Erik Lysholm, March, 312
—formation of layer images in roentgen diagnosis (ab), C. G. Sundberg and Stig Lindholm, March, 312
—method for the radiography of superficial layers (superficial tomography by vertical tube motion) (ab), Olle Olsson, March, 312
—simple apparatus (ab), Percival A. Robin, Feb., 207
—tomography (ab), J. B. McDougall, Feb., 207
—two cases of spinal anomaly, best demonstrated by laminagraphy, John H. Gilmore, Richard C. Stauffer, and Lewis G. Jacobs, May, 514
- BOECK SARCOID.** See Sarcoidosis
- BOGART, FRANKLIN B.** See **IMLER, ALLISON E.**
- BOGER, WILLIAM P., Jr.** See **HUFF, FRANK M.**
- BOHATYRTSCHUK, F.:** Results of micro-radiography (ab), June, 627
- BONES**
See also under names of bones and bone diseases
—hereditary multiple exostosis. Review of literature and report of case with Horner-Bernard syndrome as complication (ab), Lloyd D. Fisher, Clare Parsons, and Cecil C. Cutting, June, 622
—infantile cortical hyperostoses: preliminary report on new syndrome (ab), John Caffey and William A. Silverman, May, 538
—regeneration following osteomyelitis (ab), Laurence H. Mayers, Jan., 95
- cancer**
—cystic forms of cancer metastases (ab), Bengt Engfeldt, June, 620
—skeletal metastases in cancer of breast: study of character, incidence and response to roentgen therapy (ab), Jean Bouchard, June, 628
- diseases**
See also Osteitis
—Albright's syndrome (polyostotic fibrous dysplasia with cutaneous pigmentation in both sexes and gonadal dysfunction in females) (ab), Malcolm B. Dockerty, Ralph K. Chormley, Roger L. J. Kennedy, and David G. Pugh, April, 433
—bone sarcoma in polyostotic fibrous dysplasia (ab), Bradley L. Coley and Fred W. Stewart, April, 433
—chronic melioidosis. Case showing multiple lesions of bones, joints and lungs (ab), J. H. Mayer, May, 539
- cysts.** See Bones, cancer
—echinococcosis
—echinococcosis (ab), M. Beckett Howorth, May, 539
—fractures. See Fractures
—growth
—cleidocranial dysostosis; case (ab), Helge Eltorm, June, 621

BONES, growth—cont.

- ciclodranial dysostosis—report of case (nb), Fred G. Re-
pass, Jan., 96
- effect of severe rickets in early childhood on skeletal de-
velopment in adolescence (ab), Ethel C. Dunham and
Herbert Thoms, May, 539
- occurrence and significance of early periosteal proliferation
in diaphyses of premature infants (nb), Nils Malmberg,
April, 433
- administration of contrast medium in urography via the
bone marrow (nb), Leunert Wulldén, May, 541
- pneumocystoma of bone (nb), William Tennent, March, 301
- diffuse neurofibromatosis (von Recklinghausen's disease)
involving the bulbar conjunctiva. Report of case, with
lesions of skeletal system and skin, bodily asymmetry
and intracranial involvement (ob), Francisco Pérez Al-
fende, Jan., 87
- late lesions in encephalitis. Three cases in submarine
personnel (nb), C. C. Michel James, June, 621
- skeletal changes in acute leukoses of children (nb), Olof
Brandberg, Jan., 100
- skeletal lesions in neurofibromatosis (ed), June, 604
- unusual bone lesions in an infant, probably osteitis tuber-
culosa multiplex cystoides, F. Y. Khoo and Y. Yang,
March, 203
- bone sarcoma in polyostotic fibrous dysplasia (ab), Bradley
L. Coley and Fred W. Stewart, April, 433
- development of sarcoma in bone subjected to roentgen or
radium irradiation (ab), C. Howard Hatcher, Feb., 211
- malignancy of giant cell tumors: study of giant cell tumors
and allied infections in bone, with special reference to
their malignancy (ab), Sigurd R. Anderson, June, 620
- multiple cavernous hemangiomas of the skin, brain and
skeleton: report of case treated by roentgen rays and
observed for 7½ years (ab), Ernst A. Pohle and Elizabeth
A. Clark, March, 315
- multiple chondromatosis; unusual case, Ramsdell Gurney and
Louis Cohen, Jan., 48
- reticulum cell sarcoma (ab), Thomas Rosendal, June, 620
- roentgen treatment and course of cure of giant cell tumor
(10-12 years' cure) (ab), Gösta Jansson, April, 438
- round cell tumor resembling Ewing's tumor (ab), Robert J.
Reeves, March, 313
- sclerosing sarcoma (dangers of biopsy) (ab), James F.
Brailsford, Feb., 201

BOOK REVIEWS

- Archer, Vincent W. The Osseous System. A Handbook of
Roentgen Diagnosis, Jan., 81
- Barnard, W. G., and Robb-Smith, A. H. T., editors. Kettle's
Pathology of Tumors, Feb., 187
- Bradford, F. Keith, and Spurling, R. Glenn. The Inter-
vertebral Disc, with Special Reference to Rupture of the
Annulus Fibrosus with Herniation of the Nucleus Pul-
posus, Jan., 82
- Casper, Torbjörn, and Santesson, Lars. Studies on Pro-
tein Metabolism in the Cells of Epithelial Tumours.
Acta Radiologica Supplement LXVI, June, 606
- Denstad, Torfinn. The Radioactivity of Bone Marrow.
Acta Radiologica Supplement LII, May, 526
- Ebenius, Bertil. Cancer of the Lip. Clinical Study of 778
Cases with Particular Regard to Predisposing Factors and
Radium Therapy. Acta Radiologica Supplement
XLVIII, June, 607
- Edling, Nils P. G. Urethrocytography in the Male with
Special Regard to Micturition. Acta Radiologica Supple-
ment LVIII, April, 417
- Engset, Arne. Cerebral Angiography with Perabrodil
(Carotis Angiography). Acta Radiologica Supplement
LVI, April, 417
- Farrell, John T., Jr. Roentgen Diagnosis of Diseases of the
Gastro-Intestinal Tract, May, 525
- Glasser, Otto. Dr. W. C. Röntgen, Feb., 186
- Höber, Rudolf. Physical Chemistry of Cells and Tissues,
Feb., 187
- Homans, John. Textbook of Surgery, March, 287
- Hultberg, Sven. Untersuchungen über die Röntgennah-
bestrahlung. Eine Studie über physikalische Leistungen
und klinische Ergebnisse mit dem Philips Metalix-
strahl-Therapie-Apparat. Acta Radiologica Supple-
ment LIV, May, 526
- Kjellberg, Sven Rolfand. Hystero-Salpingo-Pelviographie.
Acta Radiologica Supplement XLIII, April, 416
- Krebs, Carl, Thordarson, Oskar, and Harbo, Johannes. Ex-
periments with Mammalian Sarcoma Extracts in Regard
to Cell-Free Transmission and Induced Tumor Immunity:
Further Studies of the Krebs-Rask-Nielsen, Wagner Sar-
coma. Acta Radiologica Supplement XLIV, May, 525
- Major, Ralph H. Classic Descriptions of Disease, with Bio-
graphical Sketches of the Authors, Feb., 188
- Nordentoft, Jens Munk. The Value of the Barium Enema
in the Diagnosis and Treatment of Intussusception in
Children. Illustrated by About Five Hundred Danish
Cases. Acta Radiologica Supplement LI, April, 416
- Röden, Sture. On Cancer of the Breast, with Special Ref-
erence to the Results of Different Methods of Treatment.
Acta Radiologica Supplement LVII, April, 417

BRAIN

- See also Dura Mater
abnormalities
- congenital absence of the septum pellucidum associated
with internal hydrocephalus, William P. Savain, March,
270
- diagnosis and treatment of strictures of aqueduct of Sylvius
(causing hydrocephalus) (ab), Walter E. Dandy, June,
612
- mid-line anomalies of brain: their diagnosis by pneumo-
encephalography, Arthur P. Echternacht and John A.
Campbell, Feb., 119
- cinematography in cerebral angiography (ab), Olov F.
Holm, May, 531
- cysticercosis
- ventriculographic diagnosis of cysticercosis of posterior fossa
(ab), Roman Arana and A. Asenjo, March, 293
- skull defect and herniation of cerebrum with absence of dura
following head injury in adolescence (ab), Wm. S. McCune
and Barnes Woodhall, Feb., 193
- roentgenography. See also other headings under Brain
- observations on presence of subdural gas after pneumo-
encephalography, L. W. Paul and T. C. Erickson, Feb.,
139
- tumors
- diagnostic use of radioactive common salt (ab), Gunnar
Sohrne, Feb., 207
- multiple cavernous hemangiomas of skin, brain and skele-
ton: report of case treated by roentgen rays and observed
for 7½ years (ab), Ernst A. Pohle and Elizabeth A. Clark,
March, 315
- BRANDBERG, OLOF: Skeletal changes in the acute leukoses of
children (ab), Jan., 100
- BRANDEL, ENAR: Two cases of internal biliary fistulae (ab),
June, 619
- BREAST
cancer
- clinical effects of surgical and x-ray castration (ab), Frank
E. Adair, Norman Treves, Joseph H. Farrow, and Isabel
M. Scharnagel, March, 312

- Schwedel, John B. Clinical Roentgenology of the Heart.
Annals of Roentgenology, Vol. XVIII, March, 287
- Steinert, Ragnar. Renal Tuberculosis and Roentgenologic
Examination. A Survey and a Comparison Between the
Efficiency of Different Diagnostic Methods in Sixty Cases
of Surgical Renal Tuberculosis, with a Special View to the
Roentgenologic Diagnostic. Acta Radiologica Supple-
ment LIII, April, 417
- Stokkeland, Eivind. Radiotherapy in Actinomycosis. Acta
Radiologica Supplement L, May, 525
- Strandqvist, Magnus. Studien über die kumulative Wirkung
der Röntgenstrahlen bei Fraktionierung. Erfahrungen aus
dem Radiumhemmet an 280 Haut- und Lippenkarzi-
nomen. Acta Radiologica Supplement LV, May, 526
- Torgersen, Johan. The Muscular Build and Movements of
the Stomach and Duodenal Bulb, Especially with Regard
to the Problem of Segmental Divisions of the Stomach in
the Light of Comparative Anatomy and Embryology.
Acta Radiologica Supplement XLV, April, 416
- Waters, Charles A., Firor, Whitmer B., and Kaplan, Ira I.,
editors. The 1945 Year Book of Radiology, Feb., 186
- BOOKS RECEIVED**
- Fey, Bernard, and Truchot, Pierre. Urographie intra-
veineuse, March, 286
- Forssberg, Arne G. Studien über einige biologische Wirk-
ungen der Röntgen- und γ-Strahlen, insbesondere am
Phycomyces blakesleeanus. Acta Radiologica Supplement
XLIX, April, 416
- Fraenkel, Marta, editor. IIé Congres International de Lutte
Scientifique et Sociale Contre le Cancer, Bruxelles 20-26
Septembre 1936. Travaux scientifiques, Jan., 81
- Selected Papers from the Royal Cancer Hospital (Free) and
the Chester Beatty Research Institute, Vol. III, 1941-
1942, April, 416
- Steindler, Arthur, and Marxer, Louis. Traumatic Deformities
and Disabilities of the Upper Extremity, June, 606
- Tiscornia, Rodolfo E. El torax radiológico del niño en las
enfermedades infecto-contagiosas, June, 606
- BORAK, J.: Tendogenetic disease and its treatment with x-rays
(ab), Feb., 208
- BORRELLI, FRANK J., and GREEN, GEORGE G.: Renal
rickets—case report (ab), March, 303
- BOTHE, ALBERT E.: Relationship of epithelial buds to carci-
noma of the pelvis of the kidney, ureter and bladder (ab),
Jan., 104
- BOUCHARD, JEAN: Skeletal metastases in cancer of the breast:
study of the character, incidence and response to roentgen
therapy (ab), June, 628
- BOYD, HAROLD B.: See de LORIMIER, ALFRED A.
- BOYD, HAROLD B.: See de LORIMIER, ALFRED A.
- See WRIGHT, R. WESLEY
- BOYDEN, EDWARD A., and LAYNE, JOHN A.: The gall-
bladder in patients with pernicious anemia; study of non-
visualization and rate of emptying (ab), Jan., 94
- BRAESTRUP, CARL B.: Protection measurements of lead-
shielded radium, April, 385
- BRAILSFORD, JAMES F.: Sclerosing sarcoma of bone (dangers
of biopsy) (ab), Feb., 201

BREAST, cancer—cont.

- effect of insoluble radiophosphorus (chromium phosphate) when applied interstitially in the treatment of adenocarcinoma of mamma in mice (ab), Harry Allen, L. H. Hempelmann, Jr., and Nathan A. Womack, March, 318
- effects of roentgen radiation on thymonucleic acid content of transplantable mammary carcinomas (ab), Robert E. Stowell, Jan., 106
- energy absorption [integral dose] in the trunk in the radium treatment of breast cancer by interstitial and surface applicator methods, C. W. Wilson, April, 364
- irradiation in carcinoma (ab), Roy G. Giles, Jan., 103
- low-back pain as presenting symptom (ab), T. D. Cohn and H. Cohn, Jan., 98
- response to preoperative irradiation as clue to management (ab), Leo M. Levi, May, 542
- skeletal metastases in cancer of breast: study of character, incidence and response to roentgen therapy (ab), Jean Bouchard, June, 628
- value of orchiectomy in treatment of carcinoma of male breast, T. Leucutia, May, 441
- inflammation**
- roentgen therapy as an adjunct in management of acute postpartum mastitis (ab), Roger A. Harvey, Howard A. Spindler, and Andrew H. Dowdy, Feb., 209
- Paget's disease**
- with special reference to its course and treatment (ab), Karen Lübschitz, May, 543
- tumors**
- adenofibrosis mammae. Norwegian Radium Hospital's material 1932-1942 (ab), Rolf B. Engelstad and Rolf Weyde, April, 437

BREM, THOMAS H., and COHN, HAROLD A.: Paragonimus westermani: a case report, May, 511

BRODERS, ALBERT C. See FIGI, FREDERICK A.

BRONCHI

- cancer. See Lungs, cancer
- roentgenography. See also Tuberculosis, Pulmonary, roentgenography
- bronchography as diagnostic aid in chest disease (ab), George S. McReynolds, Jr., and Fred W. Shelton, Jan., 88
- roentgenology of draining bronchi from tuberculous cavities, Mortimer R. Camiel, Jan., 24

BRONCHIECTASIS

- non-disabling bronchiectasis, Archie Fioe and T. B. Steinhäusen, March, 237

BRONCHOPNEUMONIA

- necrotizing bronchopneumonia: its relation to radiation therapy of cancer of oral cavity (ab), Lauren V. Ackerman, H. M. Wiley, and David V. LeMone, Jan., 103

BRONZE STAR MEDAL

- awarded to Dr. Lauriston S. Taylor, Jan., 81

BROWNE, DONOVAN C. See MCHARDY, GORDON

BRYAN, LOYD (obit), April, 414

BRYANT, J. EDMOND. See BLOCH, ROBERT G.

BUCKLEY, E. JAMES: Pellegrini-Stieda disease (ab), March, 304

BURNS

- See also Cathode Rays
- mechanism of shock from burns and trauma traced with radiosodium (ab), Charles L. Fox, Jr. and Albert S. Keston, April, 440
- BUSCHKE, FRANZ, and CANTRIL, SIMEON T.:** Irradiation failures in early cervical cancer. Improved radiation or return to surgery? (ab), May, 543
- BUTLER, ALLAN M.** See TALBOT, NATHAN B.
- BUTLER, ROBERT W.** See RILEY, EDWARDS M.
- BYSSINOSIS**
- pneumoconiosis due to cotton dust (byssinosis): case report, Paul V. McCarthy and Walton R. Akenhead, Jan., 46

C

CADE, STANFORD, and STEBBING, F. G.: Discussion on the radiotherapy of tumours of the kidney and bladder (ab), March, 314

CAFFEY, JOHN, and SILVERMAN, WILLIAM A.: Infantile cortical hyperostoses: preliminary report on a new syndrome (ab), May, 538

CAHILL, GEORGE F.: Hormonal tumors of the adrenal (ab), Jan., 95

CAISSON DISEASE

- late bone lesions. Three cases in submarine personnel (ab), C. C. Michael James, June, 621

CALCANEUM

- abnormality of calcaneum as cause of painful heel. Its diagnosis and operative treatment (ab), A. Fowler and J. F. Philip, March, 305

CALCIFICATION

- See also Aorta; Mitral Valve; etc.
- "metastatic" calcification in soft tissues of legs in osteitis deformans: case report (ab), Bernard Seligman and Louis Nathanson, June, 624
- tissue calcification and renal failure produced by massive dose vitamin D therapy of arthritis (ab), T. S. Danowski, A. W. Winkler, and J. P. Peters, June, 624

CAMIEL, MORTIMER R.: Roentgenology of draining bronchi from tuberculous cavities, Jan., 24

Roentgenology of massive conglomerate lesions of silicosis (ab), April, 425

Tuberculous arthritis of the shoulder, June, 569

CAMPBELL, JOHN A. See ECHTERNACHT, ARTHUR P.

CAMPBELL, PAUL A.: Aerosinusitis—a résumé (ab), Jan., 87

CANCER

- See also Sarcoma; Tumors; and under names of organs
- cancer research, Committee on Growth, of the National Research Council, Jan., 80
- implications from studies with physical carcinogens (ab), Paul S. Henshaw, April, 440
- organization and administration of gynecologic tumor clinic, with certain observations concerning therapy (ab), Clayton T. Beecham and Thaddeus L. Montgomery, March, 313
- problems of cancer biology (ab), R. R. Spencer, Jan., 102
- metastases. See also Bones, cancer
- effect of deep x-rays on peritoneal metastases of ovarian carcinoma (ab), James Watt, Jan., 104
- "Krukenberg tumors." Roentgen and gastroenterological aspects of secondary ovarian carcinoma (ab), Robert M. Lowman and Samuel D. Kushlan, March, 306
- multiple**
- multiple carcinomas. Case of 4 consecutive primary carcinomas with apparent cure (ab), C. A. Holland, April, 438
- roentgen therapy
- experiences with roentgen rotation therapy (ab), Lars Edling, April, 439
- therapy
- discussion on post-war organization (ab), E. Rock Carling, George F. Stebbing, John R. Nuttall, et al, Jan., 102

CANDEL, SAMUEL: Varicose veins of the upper extremity. Report of two cases (ab), March, 311

CANNON'S POINT. See Colon

CANNULA

- x-ray studies in hysterosalpingography, using a new cannula (ab), A. P. Hudgins, Jan., 101

CANTRIL, SIMEON T. See BUSCHKE, FRANZ

CARBON TETRACHLORIDE

- carbon tetrachloride poisoning. Report of 20 cases with one death (ab), S. M. Dillenberg and C. M. Thompson, June, 613

CARDENAS, L., and WEATHERWAX, J. L.: New method of making radon ointment, April, 381

CARDIA. See Stomach**CARDIOVASCULAR SYSTEM**

- diagnostic use of radioactive common salt (ab), Gunnar Söhrne, Feb., 207
- gastro-intestinal disorders simulating circulatory disease and vice versa (ab), Franz M. Groedel, Jan., 93

CARLING, E. ROCK, STEBBING, GEORGE F., NUTTALL, JOHN R., et al: Discussion on post-war organization for the treatment of cancer (ab), Jan., 102

CASTRATION

- See also Ovary
- value of orchiectomy in treatment of carcinoma of male breast, T. Leucutia, May, 441

CASTRONUOVO, JOHN J.: Renal osteodystrophy. Report of a case of unusual pathogenesis (ab), Feb., 201

CASWELL, H. T. See ROSEMOND, G. P.

CATHODE RAYS

- superficial "burns" of skin and eyes from scattered cathode rays, Laurence L. Robbins, Joseph C. Auh, Oliver Cope, David G. Cogan, John L. Langohr, R. W. Cloud, and Oliver E. Merrill, Jan., 1

CAYER, DAVID. See RUFFIN, JULIAN M.

CECUM. See Intussusception**CELLS**

- cellular dynamics in intestinal mucosa: effect of irradiation on epithelial maturation and migration (ab), Nathan B. Friedman, May, 537
- studies in vitro on cellular physiology. Effect of x-rays on survival of cells, Robert Schreck, April, 395

CEREBROSPINAL FLUID

- pantopaque myelography: results, comparison of contrast media, and spinal fluid reaction (ab), William G. Peacher and Robert C. L. Robertson, March, 303

CEREBRUM. See Brain**CHEST.** See Thorax

CHILDE, ARTHUR E.: Role of the x-ray in the diagnosis of posterior herniation of the intervertebral disc (ab), April, 431

CHILDREN

- See also Infants
- calcification of intervertebral discs in childhood (ab), H. Stephens Weens, Jan., 97
- effect of severe rickets in early childhood on skeletal development in adolescence (ab), Ethel C. Dunham and Herbert Thoms, May, 539
- gastric and duodenal ulcers in infancy and in childhood (ab), Edward J. Donovan and Thomas V. Santulli, Jan., 93
- intussusception in children: spontaneous reduction and sources of error in its diagnosis (ab), Hans Hellmer, April, 428
- obstruction of the ureter in children (ab), Charles J. Kickham, April, 436
- obstructive pulmonary emphysema associated with pneumonia in childhood (ab), Jerome S. Leopold and Emil A. Kratzman, May, 534
- primary coccidioidomycosis: possible pediatric problem (ab), Ralph H. Kunststadter and Robert C. Pendergrass, Jan., 90
- roentgen changes associated with pancreatic insufficiency in early life, Edward B. D. Neuhauser, April, 319
- roentgenological changes in lead poisoning (ab), Stig Radner, March, 305

CHILDREN—cont.

- skeletal changes in acute leukoses of children (ab), Olof Brandberg, Jan., 100
- varices of esophagus in children (ab), C. J. Iinsson, March, 298

CHOANAE. See Nose

- CHOLECYSTOGRAPHY.** See Gallbladder, roentgenography
- CHOLELITHIASIS.** See Gallbladder, calculi
- CHOLESTEATOMA.** See Tumors, cholesteatoma
- CHONDRODYSSTROPHIA.** See Achondroplasia
- CHONDROMA.** See Tumors, chondroma
- CHRISTIANSEN, HARALD:** Some practical hints on the performance of urography on infants (ab), June, 626
- CHROM, S. A.:** On the incidence of osteochondrosis (ab), June, 622

—See THOMSEN, GREGERS

CHROMIUM PHOSPHATE (RADIOPHOSPHORUS). See Radioactivity

CINEMATOGRAPHY

- in cerebral angiography (ab), Olof F. Holm, May, 531
- on possibility of studying the function of the heart with the aid of roentgen-cinematography. Roentgen-cinematography combined with electric recordings of resistance of cardiac valves (ab), Sven Benner, Sven R. Kjellberg, and Torgny Sjöstrand, May, 536
- roentgen cinematography as routine method (ab), Bengt S. Holmgren, June, 627

CIRCULATION. See Cardiovascular System

- CLAGETT, O. THERON.** See McDONALD, JOHN R.
- CLARK, ELIZABETH A.** See POHLE, ERNST A.
- CLARKSON, J.** See LEDERMAN, M.
- CLAUSEN, ARNE:** Peripheral aneurysm of the pulmonary artery (ab), Feb., 205

Unusual case of pure colon invagination (ab), April, 429

CLAVICLE

- osteomyelitis (ab), Tina Gray, March, 304
- solitary eosinophilic granuloma (ab), Benjamin B. Greenberg and Albert J. Schein, Jan., 96

CLEIDOCRANIAL DYSOSTOSIS. See Bones, growth

- CLEPHAN, DOROTHY F.:** Technique for auto-radiographs of radium containers (ab), April, 439

CLOUD, R. W. See ROBBINS, LAURENCE L.

- COBURN, DONALD E.:** Delayed rupture of the extensor pollicis longus tendon following Colles' fracture (ab), March, 304

COCCIDIOIDOMYCOSIS

- primary coccidioidomycosis: possible pediatric problem (ab), Ralph H. Kunstadter and Robert C. Pendergrass, Jan., 90

COGAN, DAVID G. See ROBBINS, LAURENCE L.

- COHEN, LOUIS.** See GURNEY, RAMSDELL
- COHN, BERNARD N. E.:** True oxycephaly with syndactylism. Case report (ab), March, 294

COHN, H. See COHN, T. D.

COHN, HAROLD A. See BREM, THOMAS H.

- COHN, T. D., and COHN, H.:** Low-back pain as the presenting symptom of malignant breast tumors (ab), Jan., 98

COLCHICINE

- effect of colchicine and x-rays on onion root tips (ab), Michael Levine, Jan., 106

COLE, LEWIS GREGORY: Friedenwald medalist, Jan., 81

- COLEY, BRADLEY L., and STEWART, FRED W.:** Bone sarcoma in polyostotic fibrous dysplasia (ab), April, 433

COLLEDGE, LIONEL. See DAVIS, E. D.

COLLES FRACTURE. See Radius, fractures

COLON

See also Sigmoid

- periodic, spontaneously remittent volvulus and the symptoms in cases of colon elongation (ab), Flemming Nørsgaard, June, 618
- roentgenologic manifestations of amebiasis of large intestine (ab), A. Druckmann and S. Sehor, June, 618
- significance of Cannon's point in normal and abnormal functions of colon (ab), Julian Arendt, June, 618

dilatation

- megacolon in newborn. Clinical and roentgenological study with special regard to pathogenesis (preliminary report) (ab), Th. Eberpreis, April, 429

istula. See Fistula

intussusception. See Intussusception

megacolon. See Colon, dilatation

tumors

- intermittent colon invagination on basis of tumor; cases (ab), Gösta Lindquist, April, 429

CONJUNCTIVA

- diffuse neurofibromatosis (von Recklinghausen's disease) involving the bulbar conjunctiva. Report of case, with lesions of skeletal system and skin, bodily asymmetry and intraocular involvement (ab), Francisco Páez Allende, Jan., 87

CONNOLLY, PAUL J. See REXFORD, W. K.

- COOPER, A. G. S., and ROBERTSON, D. F.:** Treatment of post-irradiational ulcers by radon ointment (ab), Feb., 212

COOPER, RALPH R. See POLLARD, H. MARVIN

COPE, OLIVER. See ROBBINS, LAURENCE L.

COPEMAN, BENJAMIN. See KEENE, CLIFFORD H.

- CORAY, QUINCE B.:** Case of crossed renal ectopia (ab), March, 309

COTTON INDUSTRY

- pneumoconiosis due to cotton dust (byssinosis): case report, Paul V. McCarthy and Walton R. Akenhead, Jan., 46

- COVENTRY, M. B., GHORMLEY, R. K., and KERNOHAN, J. W.:** The intervertebral disc: its microscopic anatomy and pathology. Part I. Anatomy, development, and physiology. Part II. Changes in the intervertebral disc concomitant with age. Part III. Pathological changes in the intervertebral disc (ab), April, 431

CRANIOMETRY

- pelviccephalometry, Tom A. Kendig, April, 391

CRANIUM

- cleidocranial dysostosis; case (ab), Helge Eltorm, June, 621
- cleidocranial dysostosis—report of case (ab), Fred G. Reppas, Jan., 96
- diffuse neurofibromatosis (von Recklinghausen's disease) involving the bulbar conjunctiva. Report of case, with lesions of skeletal system and skin, bodily asymmetry and intraocular involvement (ab), Francisco Páez Allende, Jan., 87
- enlarged parietal foramina and similar shadows seen in osteoporosis circumscripta: two cases, Charles H. Kelley, June, 601
- radiotherapy and intraocular pressure (ab), Marie B. Tsuker, March, 317
- roentgen anatomy of skull in newborn infant, Samuel G. Henderson and Louise S. Sherman, Feb., 107
- fractures**
- skull defect and herniation of cerebrum with absence of dura following head injury in adolescence (ab), Wm. S. McCune and Barnes Woodhall, Feb., 193
- tumors**
- isolated myeloma in fourteen year old boy (ab), Justus Kaufman, June, 620

CRAW, JOHN. See SUTHERLAND, CHARLES L.

CREeping ERUPTION

- Loeffler's syndrome associated with creeping eruption (cutaneous helminthiasis) (ab), D. O. Wright and Edwin M. Gold, June, 614

- CRILE, GEORGE, Jr., and JAFFE, HENRY L.:** Pancreatic calculi as a rare cause of intestinal hemorrhage. Report of case, June, 586

CRUTCHLOW, EVERETT F. See PEIRCE, CARLETON B.

- CRIMBLE, P. T.:** Ulcer of the second part of the duodenum (ab), March, 299

CRYPTOCOCCUS HISTOLYTICUS. See Blastomycosis

- CRYSLER, W. E., and MORTON, H. S.:** Osteochondritis dissecans of the supratrochlear septum of the humerus (ab), May, 540

CUTTING, CECIL C. See FISHER, LLOYD D.

CYSTICERCOSIS. See Brain

D

- DAHL-IVERSEN, E., and FOGH, BØRGE:** On the reduction of ileal-ileocolic intussusception by means of contrast enema (ab), Feb., 200

- DAILEY, MORRIS E., and MILLER, EARL R.:** Search for symptomless gastric cancer in 500 apparently healthy men of forty-five and over (ab), June, 617

- DANDY, WALTER E.:** Diagnosis and treatment of strictures of the aqueduct of Sylvius (causing hydrocephalus) (ab), June, 612

- DANOWSKI, T. S., WINKLER, A. W., and PETERS, J. P.:** Tissue calcification and renal failure produced by massive dose vitamin D therapy of arthritis (ab), June, 624

- DANZER, JOSEPH T.:** Roentgenograms of the chest in mental deficiency. March, 244

DAVID ANDERSON-BERRY PRIZE, March, 286

- DAVIES, HUGH:** Lateral prolapse of the cervical intervertebral disc (ab), Feb., 203

- DAVIS, E. D., COLLEDGE, LIONEL, LEDERMAN, M., et al:** Discussion on treatment of carcinoma of the larynx (ab), March, 312

DEAN, ARCHIE L.: Wilms' tumors (ab), April, 438

DeBAKEY, MICHAEL. See OCHSNER, ALTON

DEGLUTITION

- passage of contrast substances through the hypopharynx (ab), Karl Søndergaard, June, 612

- singular case of Plummer-Vinson syndrome (ab), Aage Vidbæk, May, 536

- solitary and multiple carcinomas of upper alimentary tract: their location, age and sex incidence and correlation with Plummer-Vinson syndrome (ab), Aage Vidbæk, June 617

- DEHNE, ERNST:** Fractures at the upper end of the humerus. Classification based on the etiology of the trauma (ab), Jan., 98

DEIBERT, G. A. See MURBACH, C. F.

de LORIMIER, ALFRED A., MINEAR, WILLIAM L., and BOYD, HAROLD B.: Reflex hyperemic deossifications of regional to joints of the extremities, March, 227

- del REGATO, JUAN A.:** Treatment of carcinoma of the cervix, June, 579

DIABETES MELLITUS

- cardiac hypertrophy and extramedullary erythropoiesis in newborn infants of prediabetic mothers (ab), Herbert C. Miller, Feb., 199

DIAPHRAGM

See also Hernia, diaphragmatic

- diaphragmatic intussusception; 4 cases (ab), Aage Wagner, June, 619

- mechanical paralysis of left hemidiaphragm complicating collapse therapy in pulmonary tuberculosis (ab), Oscar Feinsilver, Feb., 194

- DICKERSON, W. W.:** Characteristic roentgenographic changes associated with tuberous sclerosis (ab), Jan., 87
- DIGESTIVE SYSTEM**
See also Colon; Duodenum; Gastro-Intestinal Tract; Stomach; etc.
- cancer**
—solitary and multiple carcinomas of upper alimentary tract: their location, age and sex incidence, and correlation with Plummer-Vinson syndrome (ab); Aage Videbæk, June, 617
- DILLEBERG, S. M., and THOMPSON, C. M.:** Carbon tetrachloride poisoning. Report of twenty cases with one death (ab), June, 613
- DIVERTICULA.** See Intestines, diverticula
- DIXON, J. LEONARD.** See OCHSNER, ALTON
- DMYTRYK, EUGENE T.:** Congenital malformations of the anus and rectum: clinical study (ab), March, 300
- DOAN, CHARLES A.:** See HOSTER, HERMAN A.
- DOCKERTY, MALCOLM B., GHORMLEY, R. K., KENNEDY, ROGER L. J., and PUGH, DAVID G.:** Albright's syndrome (polyostotic fibrous dysplasia with cutaneous pigmentation in both sexes and gonadal dysfunction in females) (ab), April, 433
- DOFF, SIMON D.:** See LOWMAN, ROBERT M.
- DOHN, KAI, and FABER, BÖRGE:** Invagination of the stomach: case diagnosed by means of roentgen examination (ab), June, 617
- DONLAN, C. P.:** See KASABACH, H. H.
- DONOVAN, EDWARD J., and SANTULLI, THOMAS V.:** Gastric and duodenal ulcers in infancy and in childhood (ab), Jan., 93
- DONOVAN ORGANISMS.** See Granuloma inguinale
- DORMER, B. A., FRIEDLANDER, J., and WILES, F. J.:** Bronchography in pulmonary tuberculosis: artificial pneumothorax (ab), May, 532
- Bronchography in pulmonary tuberculosis: geographical adventure (ab), April, 425
- , **FRIEDLANDER, J., WILES, F. J., and SIMSON, F. W.:** Tumor of the lung due to *Cryptococcus histolyticus* (blastomycosis) (ab), June, 613
- DOWDY, ANDREW H.:** See HARVEY, ROGER A.
- DOWLING, JAMES R.:** Osteoma of the frontal sinus. Report of five cases (ab), Jan., 88
- DOWNES, JEAN.** See REISNER, DAVID
- DRAPER, JOHN W., and SICELUFF, JOSEPH G.:** Excretory cysto-urethrograms (ab), Feb., 204
- DRESSER, R.:** See SMITH, GEORGE V. S.
- DRUCKMANN, A., and SCHORR, S.:** Roentgenological manifestations of amebiasis of the large intestine (ab), June, 618
- DUFRESNE, ORIGENE:** Value of hysterosalpingography in diagnosis of gynecological affections (ab), April, 435
- DUNGAL, NIELS:** Rickets in Iceland (ab), June, 621
- DUNHAM, ETHEL C., and THOMS, HERBERT:** Effect of severe rickets in early childhood on skeletal development in adolescence (ab), May, 539
- DUNNER, LASAR:** Observations on pulmonary disease in graphite workers (ab), Feb., 196
- DUODENUM**
—congenital obstruction. Report of 6 cases and review of literature, Friedrich G. Kautz, James R. Lisa, and Ernest Kraft, April, 334
- roentgenography
—aberrant pancreatic tissue as roentgenologic problem (ab), George J. Baylin, Jan., 94
- new x-ray method of studying anatomy and motility: its diagnostic value (ab), Walter F. Gruber, Feb., 199
- radiographic diagnosis of prolapsed redundant gastric mucosa into the duodenum, with remarks on the clinical significance and treatment, Wendell G. Scott, June, 547
- ulcers. See Peptic Ulcer
- DURA MATER**
—displacement of pineal gland with extradural hemorrhage (ab), M. J. Madonick and Ignaz W. Oljenick, Feb., 193
- observations on presence of subdural gas after pneumo-encephalography, L. W. Paul and T. C. Erickson, Feb., 139
- skull defect and herniation of cerebrum with absence of dura following head injury in adolescence (ab), Wm. S. McCune and Barnes Woodhall, Feb., 193
- DUST DISEASES.** See Pneumoconiosis
- DUSZYNSKI, DIANA O.:** See SCATCHARD, GEORGE N.
- DUVERNAY'S "FORAGE."** See Epiphyses
- DWARFISM**
See also Achondroplasia
—infantile dwarfism (encephalomyelitis) in siblings (ab), John Monfort, Silik H. Polayes, and Reuben Sorkin, June, 621
- renal**
—renal osteodystrophy. Report of case of unusual pathogenesis (ab), John J. Castronuovo, Feb., 201
- renal rickets—case report (ab), Frank J. Borrelli and George G. Green, March, 303
- DYSGERMINOMA.** See Tumors, seminoma
- DYSOSTOSIS.** See Bones, growth
- DYSPLASIA.** See Deglutition
- DYSPLASIA, POLYOSTOTIC FIBROUS.** See Bones, diseases
- E
- EAGLESHAM, D. C.:** Observations on opaque myelography of lumbar disc herniations (ab), Feb., 202
- EBSTEIN'S DISEASE.** See Tricuspid Valve
- ECHINOCOCCOSIS.** See Bones
- ECHLIN, FRANCIS A., IVIE, JOSEPH McK., and FINE, ARCHIE:** Pantopaque myelography as an aid in the preoperative diagnosis of protruded intervertebral discs: preliminary report (ab), Jan., 98
- ECHTERNACHT, ARTHUR P.:** Injuries of the urinary tract: roentgenological considerations (ab), April, 436
- and **CAMPBELL, JOHN A.:** Mid-line anomalies of the brain: their diagnosis by pneumoencephalography, Feb., 119
- ECKHARDT, ROBERT E.** See STEVENSON, LEWIS D.
- ECONOMICS, MEDICAL**
—hospital fluorophotography: its implications (letter to the editor), J. Edwin Habbe, May, 523
- EDDY, C. E., and STEVENS, D. J.:** Some observations on x-ray treatment cones, Feb., 176
- EDEMA**
—roentgenologic soft-tissue studies of the skin and subcutaneous tissue: contribution to roentgen study of edema (ab), Arne Prantzell, March, 310
- EDER, HOWARD, HAWN, CLINTON V., and THORN, GEORGE:** Report of case of acute interstitial fibrosis of the lungs (ab), Feb., 194
- EDITORIALS**
Acta Radiologica, Leo G. Rigler, April, 411
- cystic fibrosis of pancreas, April, 412
- latent period which elapses between onset of lesion and appearance of radiographic signs, James F. Brailsford, Feb., 184
- Lowell S. Goin, M.D., president of the Radiological Society of North America, Jan., 77
- presidential address, Lewis G. Allen, March, 282
- radiology and atomic power, May, 521
- skeletal lesions in neurofibromatosis, June, 604
- EDLING, LARS:** Experiences with roentgen rotation therapy (ab), April, 439
- EDWARDS, PETER W., PENMAN, A. CLARK, and BLAIR, L. G.:** Primary tuberculous infection in a sanatorium staff. Investigation and supervision (ab), Feb., 194
- EFFUSIONS.** See Knee; Pleura; Peritoneum
- EGBERT, E. WAYNE, and FULLER, ALFRED G.:** A simple polygraph, June, 594
- EHNI, GEORGE, and LOVE, J. GRAFTON:** Intraspinal lipomas. Report of cases, review of literature, and clinical and pathologic study (ab), Jan., 102
- EHRENPREIS, TH.:** Megacolon in the newborn. Clinical and roentgenological study with special regard to pathogenesis (preliminary report) (ab), April, 429
- EICHWALD, MAX, and SINGLETARY, WILLIAM V.:** Transient successive pulmonary infiltrations (Löfller's syndrome), March, 258
- EINSTEIN, ROBERT A. J.** See KERR, H. DABNEY
- ELBOW**
—internal epicondylar epiphysis and elbow injuries (ab), Adolf A. Schmier, Feb., 203
- osteochondritis dissecans of supratrochlear septum (ab), W. S. Millman, June, 622
- osteochondritis dissecans of supratrochlear septum of humerus (ab), W. E. Cryslar and H. S. Morton, May, 540
- ELECTROSURGERY (fulguration).** See Uterus, cancer
- ELKELES, A., and GLYNN, L. E.:** Serial roentgenograms of chest in periarthritis nodosa as an aid to diagnosis, with notes on pathology of pulmonary lesions (ab), Feb., 196
- ELLIS, F.** See GRAY, L. H.
- ELTORM, HELGE:** Case of cleidocranial dysostosis (ab), June, 621
- EMBOLISM**
pulmonary
—embolism from obscure sources (ab), Aubrey O. Hampton and Andrew G. Prandoni, and John T. King, May, 534
- EMPHYSEMA**
mediastinal
—spontaneous emphysema (ab), Samuel A. Shelburac, Jan., 91
- spontaneous emphysema (ab), M. H. Stein, June, 615
- pulmonary
—newer concepts (ab), Edgar Mayer and Israel Rappaport, March, 296
- obstructive emphysema associated with pneumonia in childhood (ab), Jerome S. Leopold and Emil A. Kratzman, May, 534
- subcutaneous
—ingestion of kerosene complicated by pneumonia, pneumothorax, pneumopericardium, and subcutaneous emphysema (ab), Arnold F. Lavenstein, Feb., 195
- ENCEPHALITIS**
—roentgen therapy for acute encephalitis (ab), U. V. Portmann and Roger Lough, April, 439
- ENCEPHALOGRAPHY.** See Brain, roentgenography
- ENCEPHALOMYELITIS**
—infantile dwarfism (encephalomyelitis) in siblings (ab), John Monfort, Silik H. Polayes, and Reuben Sorkin, June, 621
- ENDOCARDITIS**
—dextrocardia with situs inversus complicated by chronic aortic and mitral endocarditis (ab), George W. Parson, June, 616
- ENDOMETRIUM.** See Uterus
- ENEMA**
—reduction of ileal-ileocolic intussusception by means of contrast enema (ab), E. Dahl-Iversen and Børge Fogh, Feb., 200
- ENGELSTAD, ROLF B., and WEYDE, ROLF:** Adenofibrosis mammae. The Norwegian Radium Hospital's material 1932-1942 (ab), April, 437

ENGELFELD, BENGT: Cystic forms of cancer metastases in bones (nb), June, 620
ENZER, NORBERT, SIMONSON, ERNST, and EVANS, A. M.: Clinical physiological observations on welders with pulmonary siderosis and foundry men with nodular uncomplicated silicosis (ab), May, 534

EOSINOPHILS

—Loeffler's syndrome associated with creeping eruption (cutaneous helminthiasis) (ab), D. O. Wright and Edwin M. Gold, June, 614
 —Loeffler's syndrome—eosinophilic pneumonia. Case report (ab), Sidney Scherlis, Feb., 197
 —solitary eosinophilic granuloma of bone (ab), Benjamin B. Greenberg and Albert J. Schein, Jan., 96
 —transient focal pulmonary edema (nb), Carleton B. Peirce, Everett F. Crutchenlow, Arthur T. Henderson, and Joseph W. McKay, May, 534
 —transient successive pulmonary infiltrations (Loeffler's syndrome), Max Eichwald and William V. Singleton, March, 258

EPIPHYSES

—Duvernay's "forage" of femoral epiphysis: follow-up examination of 41 cases (ab), Jørgen Ernst, June, 623
 —epiphysitis of ischial tuberosity: case report (ab), Paul E. McMaster, May, 540
 —etiology of osteochondrosis dissecans (ab), S. Ribbing, April, 433
 separation
 —conservative management of adolescent slipping of capital femoral epiphysis (nb), Robert D. Moore, Jan., 99
 —internal epicondylar epiphysis and elbow injuries (nb), Adolf A. Schmier, Feb., 203

EPILOIC APPENDAGES. See Intestines

EPITHELIOMA. See Skin, cancer

EPITHELIUM

—cellular dynamics in intestinal mucosa: effect of irradiation on epithelial maturation and migration (ab), Nathan B. Friedman, May, 537
 —relationship of epithelial buds to carcinoma of pelvis of kidney, ureter and bladder (ab), Albert E. Bothe, Jan., 104
EPSTEIN, BERNARD S.: An evaluation of teleroentgenographic mensuration and cardiac roentgenoscopy in the diagnosis of early mitral valve disease (ab), Jan., 93

ERICKSON, T. C. See PAUL, L. W.

ERNST, JØRGEN: Duvernay's "forage" of the femoral epiphysis: follow-up examination of 41 cases (ab), June, 623
ERSKINE, ARTHUR W.: Indications and limitations of transvaginal roentgen therapy for cancer of cervix, May, 458

ERYTHROCYTES

—cardiac hypertrophy and extramedullary erythropoiesis in newborn infants of prediabetic mothers (ab), Herbert C. Miller, Feb., 199

ESOPHAGUS

abnormalities
 —short esophagus (thoracic stomach) and its association with peptic ulceration and cancer (ab), D. W. Smithers, May, 536
 cancer

—radium treatment (ab), M. Lederman and J. Clarkson, Feb., 207

—roentgen diagnosis of malignant tumors within the boundary region between pharynx and esophagus (ab), Åke Åkerlund and Solve Welin, April, 422

foreign bodies. See Foreign Bodies, in air and food passages tumors

—benign tumor of esophagus and its differential diagnosis (ab), R. A. Kemp Harper and Eugene Tisceno, March, 298

—benign tumors. Report of 3 cases (ab), Ralph Adams and Walter B. Hoover, June, 616

varix

—in children (ab), C. J. Hansson, March, 298

EVANS, A. M. See ENZER, NORBERT

EVANS, E. MERVYN: Rotational deformity in the treatment of fractures of both bones of the forearm (ab), May, 541

EWING TUMORS. See Tumors, Ewing's

EXOSTOSES. See Bones; Spine

EXPLOSIONS

—blast injury to lungs: clinical and radiological findings and their relation to certain symptoms (ab), G. R. Fearnley, Feb., 197

—pulmonary concussion ("blast") in non-thoracic battle wounds (ab), Oswald Savage, Feb., 197

EXTREMITIES

See also Elbow; Fingers and Toes; Foot; etc.

—classification and diagnosis of peripheral vascular diseases (ab), Robert H. Goetz, March, 311

—"metastatic" calcification in soft tissues of legs in osteitis deformans: case report (ab), Bernard Seligman and Louis Nathanson, June, 624

—reflex hyperemic deossifications regional to joints of the extremities, Alfred A. de Lorimer, William L. Minear, and Harold B. Boyd, March, 227

—roentgenologic soft-tissue studies of skin and subcutaneous tissue: contribution to roentgen study of edema (ab), Arne Prantzell, March, 310

—varicose veins of upper extremity. Report of 2 cases (ab), Samuel Candel, March, 311

EYES

—superficial "burns" of skin and eyes from scattered cathode rays, Laurence L. Robbins, Joseph C. Aub, Oliver Cope, David G. Cogan, John L. Langohr, R. W. Cloud, and Oliver E. Merrill, Jan., 1

foreign bodies

—problems in x-ray localization in and about the eye (ab), J. A. MacMillan, Jan., 88

F

FABER, BÖRGE. See DOHN, KAI

FABER, HAROLD K., HOPE, JOHN W., and ROBINSON, FRANCIS L.: Chronic stridor in early life due to persistent right aortic arch. Report of two cases (ab), Jan., 92

FABRICIUS, BRYAN: Value of kymography for the differential diagnosis between aneurysm of the aorta and mediastinal tumor (ab), June, 615

FACE

—potential anatomical spaces (ab), Joseph G. Kostrubala, March, 293

FAIRCHILD, G. C. See GRAY, L. H.

FALLOPIAN TUBES

roentgenography

—hysterosalpingography in sterility (ab), Colin Macdonald, Jan., 100

—value of hysterosalpingography in gynecological affections (nb), Origene Dufresne, April, 435

—x-ray studies in hysterosalpingography, using a new cannula (ab), A. P. Hudgins, Jan., 101

tuberculosis

—radiographic manifestations of tuberculous salpingitis (ab), Wolfgang Magnusson, Feb., 204

FARBER, JASON E., and MILLER, D. K.: "Beriberi heart" in a tuberculous patient (ab), Feb., 199

FARMER, F. T.: Condenser ionization chambers for measurement of x-rays in body cavities: physical problems in their design (ab), April, 439

—See OSBORN, S. B.

FARROW, JOSEPH H. See ADAIR, FRANK E.

FATIGUE FRACTURE. See Femur; Fibula; Metatarsus; Tibia

FAWCITT, RICHARD. See SUTHERLAND, CHARLES L.

FEARNLEY, G. R.: Blast injury to the lungs: clinical and radiological findings and their relation to certain symptoms (ab), Feb., 197

FEEBLEMINDEDNESS

—roentgenograms of the chest in mental deficiency, Joseph T. Danzer, March, 244

FEINSILVER, OSCAR: Mechanical paralysis of the left hemidiaphragm complicating collapse therapy in pulmonary tuberculosis (ab), Feb., 194

FELD, S. M. See MELAMED, A.

FEMUR

See also Hip

cysts. See Femur, tuberculosis

epiphyses. See Epiphyses

fractures

—fatigue fracture (ab), H. R. I. Wolfe and J. M. Robertson, June, 625

—stress fracture of femoral neck (ab), John A. W. Bingham, June, 625

Pellegrini-Stieda disease

—para-articular calcification (Pellegrini-Stieda) in affections of knee (ab), I. William Nacblas and John L. Olpp, June, 623

—Pellegrini-Stieda disease (ab), E. James Buckley, March, 304

—Pellegrini-Stieda disease, Delbert A. Russell and Charles D. Smith, April, 351

tuberculosis

—cystic tuberculosis in bone and joint; case (ab), Ingolfur Blöndal, June, 622

FERKANEY, JOSEPH E., and LEE, RICHARD K. C.: Tuberculosis survey of food handlers on the island of Oahu (ab), May, 533

FIBROMA. See Uterus, fibroma

FIBROMYOMA. See Tumors, fibromyoma

FIBULA

fractures

—fatigue fracture (ab), A. Ronald, May, 541

—fatigue fracture, 2 cases (ab), David A. Richmond, Jan., 99

FIGI, FREDERICK A., BRODERS, ALBERT C., and HAVENS, FRED Z.: Plasma cell tumors of the upper part of the respiratory tract (ab), May, 532

FILARIASIS

—evaluation of roentgen therapy (ab), Henry L. Jaffe, March, 315

FINE, ARCHIE, and STEINHAUSEN, T. B.: Experiences with the photoroentgen method in chest surveys: analysis of 156,000 examinations (ab), June, 612

—Non-disabling bronchiectasis, March, 237

—See ECHLIN, FRANCIS A.

FINGERS AND TOES

abnormalities

—arachnodactyly (spider fingers) (ab), H. Gray, Feb., 203

—true oxycephaly with syndactylism. Case report (ab), Bernard N. E. Cohn, March, 294

FINK, DANIEL L. See RIGLER, LEO G.

FISHER, LLOYD D., PARSONS, CLARE, and CUTTING, CECIL C.: Hereditary multiple exostosis. Review of the literature and report of case with Horner-Bernard syndrome as a complication (ab), June, 622

FISTULA

arteriovenous

—cardiac changes (ab), Robert C. Pendergrass, March, 297

FISTULA—cont.

- biliary
 - two cases of internal fistulae (ab), Enar Brandel, June, 619
- renocolic
 - spontaneous fistula: report of case, J. E. Miller, May, 518
- FLINN, FAUNTLEROY (obit), Jan., 82
- FLOCKS, R. H.: Preventive treatment of calcium urolithiasis: important role of early and frequent roentgenographic examinations (ab), Jan., 101
- FLUKE. See Paragonimus westermanii
- FOGH, BØRGE. See DAHL-IVERSEN, E.
- FONG, E. E.: Accessory urethral channel: case, April, 380
- Some experiences with Priodax, June, 583

FOOD
—tuberculosis survey of food handlers on the island of Oahu (ab), Joseph E. Ferkany and Richard K. C. Lee, May, 533

FOOT

- See also Calcaneum; Metatarsus
- flat
 - diagnosis of pes planus by x-ray, William L. Bonnet and D. R. Baker, Jan., 36

FORAMEN

- enlarged parietal foramina and similar shadows seen in osteoporosis circumscripta: 2 cases, Charles H. Kelley, June, 601

FOREARM

- radioulnar synostosis of traumatic origin: report of case (ab), H. G. Lee, March, 304
- fractures. See also Radius
 - rotational deformity in treatment of fractures of both bones (ab), E. Mervyn Evans, May, 541

FOREIGN BODIES

- See also Eyes; Heart; Intestines
- in air and food passages
 - clinical and roentgenologic diagnosis of foreign bodies, especially fish bones, in hypopharynx and esophagus, with discussion of suitable roentgenologic method (ab), Hans-Gösta Skarby, March, 298

FOWLER, A., and PHILIP, J. F.: Abnormality of the calcaneus as a cause of painful heel. Its diagnosis and operative treatment (ab), March, 305

FOX, CHARLES L., Jr., and KESTON, ALBERT S.: Mechanism of shock from burns and trauma traced with radiosodium (ab), April, 440

FRACTURES

- See also under names of bones
- so-called retarded or occult fractures. Significance of parallel projection in roentgen diagnosis, Benedict J. Toth, May, 475
- fatigue. See Femur; Fibula; Metatarsus; Tibia
- march. See also Tibia, fractures
- march fracture, R. E. Van Demark and Paul V. McCarthy, May, 496
- stress. See Femur

FRANK, C. H.: Malignant tumors of the testis (ab), March, 315

FRANTZELL, ARNE: Roentgenologic soft-tissue studies of the skin and subcutaneous tissue: contribution to the roentgen study of edema (ab), March, 310

FRASER, KENNETH: Malignant tumours of the small intestine. Review of the literature and report of 21 cases (ab), March, 300

FRECKER, ERIC W.: Pelvic x-ray measurements and pelvic contraction (ab), April, 435

FREEDMAN, LESTER M. J., and BEINHAEUER, LAWRENCE G.: Roentgen-ray treatment of tinea capitis (ab), April, 439

FREIFELD, S. E.: Lymphoblastoma of the kidney, May, 507

FRIEDLANDER, J. See DORMER, B. A.

FRIEDMAN, LEWIS J., and FRIEDMAN, PAUL S.: Inflammatory lesions of the kidneys (ab), March, 307

FRIEDMAN, MAJOR MILTON, awarded Legion of Merit, May, 523

FRIEDMAN, NATHAN B.: Cellular dynamics in the intestinal mucosa: effect of irradiation on epithelial maturation and migration (ab), May, 537

FRIEDMAN, PAUL S. See FRIEDMAN, LEWIS J.

FRIMANN-DAHL, J.: On strangulating obstruction of the small bowel with special reference to cases with poor roentgen findings (ab), April, 428

FRONTAL BONE

- solitary myeloma (ab), Charles W. Schwartz, April, 422

FRONTAL SINUS

- roentgen picture in mucopyocele and cholesteatoma (ab), Nils Frostberg, March, 293
- tumors
 - osteoma: report of 5 cases (ab), James R. Dowling, Jan., 88
 - roentgen picture in mucopyocele and cholesteatoma (ab), Nils Frostberg, March, 293

FROSTBERG, NILS: Roentgen picture in mucopyocele and cholesteatoma in the frontal sinus (ab), March, 293

FUCHS, ARTHUR W.: Military photoroentgen technique employing optimum kilovolt (peak) principles (ab), April, 437

FULLER, ALFRED G. See EGBERT, E. WAYNE

GALLBLADDER

- calculi
 - gallstone ileus (ab), Gordon McHardy and Donovan C. Browne, March, 301

—intestinal obstruction by gallstones (ab), Maurice Lee, Feb., 200

hernia

- traumatic right diaphragmatic hernia: case with delayed herniation of liver and gallbladder (ab), Clifford H. Keene and Benjamin Copleman, June, 619

roentgenography

- comparative clinical investigation of cholecystographic preparations, George A. Unfug, May, 489

—gallbladder in patients with pernicious anemia: study of nonvisualization and rate of emptying (ab), Edward A. Boyden and John A. Layne, Jan., 94

—nursing—a source of error in cholecystography (ab), F. Polgár, May, 538

—some experiences with Priodax, E. E. Fong, June, 583

GALLUCCIO, A. C.: Advantages of supplemental radiographic studies at time of induction (ab), Jan., 89

Spondylolisthesis. Further remarks with emphasis on radiologic aspects, April, 356

GAMMA RAYS. See Radium

GANGRENE

- x-rays in diagnosis and localization of gas gangrene (ab), F. H. Kemp, Feb., 205

GARCIA, MANUEL, and SCHLOSSER, JOSEPH V.: Problem of secondary infection in carcinoma of cervix, May, 448

GARCIA-CALDERÓN, J. See GILBERT, RENÉ-J.

GARLAND, LEO H.: Myocardial infarction—roentgen diagnosis (ab), June, 616

—and **HARRIS, MILO T.:** Wet-film x-ray viewing room (ab), April, 437

GAS GANGRENE. See Gangrene

GASTRO-INTESTINAL TRACT

- See also Colon; Duodenum; Intestines; Stomach; etc.

cancer

—“Krukenberg tumors.” Roentgen and gastroenterological aspects of secondary ovarian carcinoma (ab), Robert M. Lowman and Samuel D. Kushlan, March, 306

diseases

—gastrointestinal disorders simulating circulatory disease and vice versa (ab), Franz M. Groedel, Jan., 93

—value of spot films in radiography (ab), Frank L. Hussey, March, 297

hemorrhage

—hiatus hernia of stomach as source of gastro-intestinal bleeding, Ernest A. Mendelsobn, May, 502

GASTROSCOPY. See Stomach

GAY, LENDALL C. See HUDSON, PERRY B.

GAZIN, ALBERT I. See LERNER, HENRY H.

GENETICS

—genetic injury (due to irradiation), Paul S. Henshaw, Jan., 62

GENITALS

- See also Fallopian Tubes; Ovaries; Testes; Uterus; etc.

cancer

—organization and administration of a gynecologic tumor clinic, with certain observations concerning therapy (ab), Clayton T. Beecham and Thaddeus L. Montgomery, March, 313

GHORMLEY, R. K. See COVENTRY, M. B.

—See **DOCKERTY, MALCOLM B.**

GIAN-FRANCESCHI, JOSEPH S. (obit), May, 524

GILBERT, RENÉ-J. See HALL, BYRON E.

GILBERT, RENÉ-J., and GARCIA-CALDERÓN, J.: Radiologic study of cecocolic invagination in the adult (ab), June, 618

GILES, ROY G.: Irradiation in carcinoma of the breast (ab), Jan., 103

Wilms' tumor of the kidney (ab), Feb., 208

GILMORE, JOHN H., STAUFFER, RICHARD C., and JACOBS LEWIS G.: Two cases of spinal anomaly, best demonstrated by laminography, May, 514

GLUCKSMANN, A., TANSLEY, K., and WILSON, C. W.: Effect of variations in the dose rate of gamma radiation on cell degeneration in the frog tadpole (ab), March, 317

GLYNN, L. E. See ELKELES, A.

GOETZ, ROBERT H.: Classification and diagnosis of peripheral vascular diseases (ab), March, 311

GOIN, LOWELL S., president of the Radiological Society of North America (ed), Jan., 77

GOITER

- intrathoracic goiters (ab), Frank H. Lahey, May, 536

GOLD, EDWIN M. See WRIGHT, D. O.

GOLDMAN, LEONARD B., and VICTOR, ABRAHAM W.: Hodgkin's disease. Salient clinical features and relative value of various methods of treatment based upon study of 319 cases (ab), May, 544

GONADS

- See also Ovary; Testes

—Albright's syndrome (polyostotic fibrous dysplasia with cutaneous pigmentation in both sexes and gonadal dysfunction in females) (ab), Malcolm B. Dockerty, Ralph K. Ghormley, Roger L. J. Kennedy, and David G. Pugh, April, 433

GOODMAN, S. J.: Identical twins: achondroplastic dwarfs (ab), April, 435

GOREN, SIDNEY. See RILEY, EDWARDS M.

GOULD, DAVID M.: Mass x-ray survey in San Antonio (ab), Jan., 89

Nontuberculous lesions found in mass x-ray surveys (ab), April, 425

GOYANNA, RUY, and GREENE, LAURENCE F.: Pathologic and anomalous conditions associated with duplication of the renal pelvis and ureter (ab), May, 511

- GRÄBERGER, GÖSTA:** Case of trichobezoar (ab), April, 428
- GRANULOMA**
- solitary eosinophilic granuloma of bone (nb), Benjamin B. Greenberg and Albert J. Schein, Jan., 96
 - inguinale
 - osteomyelitis caused by granuloma inguinale: report of case with cultivation of Donovan body in yolk sac of developing chick embryo (ab), Walter H. Sheldon, Ben. R. Thebant, Albert Heyman, and Margaret J. Wall, June, 619
- GRAPHITE WORKERS**
- observations on pulmonary reaction in graphite workers (nb), Lnsar Dunner, Feb., 196
- GRAY, H.:** Arachnodactyly (spider fingers) (ab), Feb., 203
- GRAY, L. H., ELLIS, F., FAIRCHILD, G. C., and PATERSON, EDITH:** Dosage rate in radiotherapy. A symposium (ab), Feb., 210
- GRAY, TINA:** Osteomyelitis of the clavicle (ab), March, 304
- GREEN, GEORGE G. See BORRELLI, FRANK J.**
- GREENBERG, BENJAMIN B., and SCHEIN, ALBERT J.:** Solitary eosinophilic granuloma of bone (ab), Jan., 96
- GREENE, LAURENCE F. See GOYANNA, RUY**
- GRISHAM, A., and KANE, I. J.:** Disseminated calcified and bony nodules in the lungs associated with mitral disease (ab), April, 426
- GROEDEL, FRANZ M.:** Gastrointestinal disorders simulating circulatory disease and vice versa (ab), Jan., 93
- GROSS, ROBERT E., and LEWIS, JAMES E.:** Defect of the anterior mediastinum: successful surgical repair (ab), March, 297
- GROSS, SIDNEY W. See SOULE, ARTHUR B., Jr.**
- GROSSMAN, J. W., and MINOR, HOWARD H.:** Roentgen demonstration of the semilunar cartilages of the knee, March, 304
- GROUT, J. L. A. See McLAUGHLIN, A. I. G.**
- GROWTH**
- See also Bones, growth
 - production, by action of pituitary gland on vascular and hemopoietic systems: interrelationship between lungs and pituitary gland (ab), Robert C. Moehlig, June, 614
- GRUBER, WALTER F.:** New x-ray method of studying the anatomy and motility of the stomach and duodenum: its diagnostic value (ab), Feb., 199
- GURNEY, RAMSDELL, and COHEN, LOUIS:** An unusual case of multiple chondromata, Jan., 48
- H**
- HAFFLY, GILBERT N.:** Value of routine roentgenographic studies of war injuries of the head and neck (ab), Feb., 193
- HAGGART, G. EDMUND. See HARE, HUGH F.**
- HAIR BALL (trichobezoar). See Stomach, foreign bodies**
- HALL, BYRON E., WATKINS, CHARLES H., HARGRAVES, MALCOLM M., and GIFFIN, HERBERT Z.:** Radioactive phosphorus in the treatment of polycythemia vera. Results and hematologic complications (ab), May, 545
- HAM, HAROLD J.:** Carcinoma of the prostate (ab), Jan., 105
- HAMARTOMA. See Tumors, chondroma**
- HAMILTON, JOHN B.:** Gastric volvulus and other abnormal rotations of the stomach (ab), May, 537
- HAMMER, HOWARD J. See BELL, JOSEPH C.**
- HAMPTON, AUBREY O., PRANDONI, ANDREW G., and KING, JOHN T.:** Pulmonary embolism from obscure sources (ab), May, 534
- HANSSON, C. J.:** Varices of the oesophagus in children (ab), March, 298
- HARDING, H. E. See McLAUGHLIN, A. I. G.**
- HARDT, LEO L., HUFFORD, A. RAY, and RABENS, J. I.:** Analytical survey of 1,132 patients gastroscopically examined (ab), April, 426
- HARDY, JANET B., and KENDIG, EDWIN L., Jr.:** Tuberculous pleurisy with effusion in infancy (ab), Jan., 89
- HARE, HUGH F.:** Present status of diagnosis and treatment of uterine carcinoma (ab), May, 543
- and HAGGART, G. EDMUND: Osteitis condensans illi (ab), May, 540
- HARGRAVES, MALCOLM M. See HALL, BYRON E.**
- HARPER, R. A., KEMP, and TISCENCO, EUGENE:** Benign tumor of the esophagus and its differential diagnosis (ab), March, 298
- HARRINGTON, STUART W. See McDONALD, JOHN R.**
- HARRIS, MILO T. See GARLAND, LEO H.**
- HARVEY, HAROLD D. See ST. JOHN, FORDYCE B.**
- HARVEY, ROGER A., SPINDLER, HOWARD A., and DOWDY, ANDREW H.:** Roentgen therapy as an adjunct in the management of acute postpartum mastitis (ab), Feb., 209
- HATCHER, C. HOWARD:** Development of sarcoma in bone subjected to roentgen or radium irradiation (ab), Feb., 211
- HAVENS, FRED Z. See FIGI, FREDERICK A.**
- HAWN, CLINTON V. See EDER, HOWARD**
- See also Cranium
- radiology of war injuries. Part IV. War wounds of the head and neck (ab), D. B. McGrigor and Eric Samuel, May, 531
 - value of routine roentgenographic studies of war injuries of head and neck (ab), Gilbert N. Haffly, Feb., 193
- HEART**
- changes in arteriovenous fistula (ab), Robert C. Pendergrass, March, 297
 - relationship between heart volume and various physical factors (ab), Gunnar Björck, June, 616
- roentgenologic determination of volume in infants. Preliminary report (ab), Oliver Axén and John Lind, April, 426
 - transient heart block in congenital heart disease (ab), Samuel Waldman, May, 535
- calcification**
- roentgen findings in intracardiac and particularly perimittal calcifications (ab), Henning Odqvist, April, 426
- dilatation**
- "beriberi heart" in tuberculous patient (ab), Jason E. Farber and D. K. Miller, Feb., 199
- displacement**
- dextrocardia with situs inversus complicated by chronic rheumatic aortic and mitral endocarditis (ab), George W. Parson, June, 616
- foreign bodies**
- intracardiac foreign body. Report of case with recovery (ab), Robert Shapiro, May, 535
- hypertrophy**
- hypertrophy and extramedullary erythropoiesis in newborn infants of prediabetic mothers (ab), Herbert C. Miller, Feb., 199
- infarction**
- myocardial infarction—roentgen diagnosis (ab), Leo H. Garland, June, 616
- roentgenography**
- evaluation of teleroentgenographic mensuration and cardiac roentgenoscopy in diagnosis of early mitral valve disease (ab), Bernard S. Epstein, Jan., 93
 - possibility of studying function of heart with aid of roentgen-cinematography. Roentgen-cinematography combined with electric recordings of resistance of cardiac valves (ab), Sven Benner, Sven R. Kjellberg, and Torgny Sjöstrand, May, 536
 - valves. See also Aortic Valve; Mitral Valve; Tricuspid Valve
 - on possibility of studying the function of the heart with the aid of roentgen-cinematography. Roentgen-cinematography combined with electric recordings of resistance of cardiac valves (ab), Sven Benner, Sven R. Kjellberg, and Torgny Sjöstrand, May, 536
- HEEL**
- abnormality of the calcaneum as cause of painful heel. Its diagnosis and operative treatment (ab), A. Fowler and J. F. Philip, March, 305
- HELLMER, HANS:** Intussusception in children: spontaneous reduction and the sources of error in its diagnosis (ab), April, 428
- HELMINTHIASIS**
- Loeffler's syndrome associated with creeping eruption (cutaneous helminthiasis) (ab), D. O. Wright and Edwin M. Gold, June, 614
- HEMANGIOMA. See Tumors, angioma**
- HEMOCHROMATOSIS. See Hemosiderosis**
- HEMOPOIETIC SYSTEM**
- production of growth by action of pituitary gland on vascular and hemopoietic systems: interrelationship between lungs and pituitary gland (ab), Robert C. Moehlig, June, 614
 - radioactive phosphorus in treatment of polycythemia vera. Results and hematologic complications (ab), Byron E. Hall, Charles H. Watkins, Malcolm M. Hargraves, and Herbert Z. Giffin, May, 545
- HEMOPTYSIS**
- relapsing, diffuse pulmonary bleedings or hemosiderosis pulmonum—a new clinical diagnosis (ab), Jan Waldenström, May, 533
- HEMOSIDEROSIS**
- idiopathic pulmonary hemosiderosis (essential brown induration) (ab), Per Selander, Jan, 91
 - relapsing, diffuse pulmonary bleedings or hemosiderosis pulmonum—a new clinical diagnosis (ab), Jan Waldenström, May, 533
- HEMPELMANN, L. H., Jr. See ALLEN, HARRY**
- HENDERSON, ARTHUR T. See PEIRCE, CARLETON B.**
- HENDERSON, SAMUEL G., and SHERMAN, LOUISE S.:** Roentgen anatomy of the skull in the newborn infant, Feb., 107
- HENNY, GEORGE C.:** X-ray protection in industrial fluoroscopy, Jan., 66
- HENOCH'S PURPURA. See Purpura**
- HENRY, M. G.:** Anomalous fusion of the scapoid and the greater multangular bone (ab), March, 305
- HENSHAW, PAUL S.:** Protection against x-rays and gamma rays. Genetic injury, Jan., 62
- Implications from studies with physical carcinogens (ab), April, 440
- HEREDITY**
- genetic injury (due to radiations), Paul S. Henshaw, Jan., 62
 - hereditary multiple exostosis. Review of literature and report of case with Horner-Bernard syndrome as complication (ab), Lloyd D. Fisher, Clare Parsons and Cecil C. Cutting, June, 622
- HERMODSSON, IVAN:** Different types of osteo-arthritis in the hip joint and their connection with the anatomical conditions. Does there exist any subluxation coxae acquisita? (ab), April, 433
- Osteochondritis dissecans of head of femur (ab), June, 622**
- HERNIA**
- See also Brain
 - diaphragmatic
 - hiatus hernia of stomach as source of gastro-intestinal bleeding, Ernest A. Mendelsohn, May, 502

HERNIA, diaphragmatic—cont.

—traumatic right hernia: case with delayed herniation of liver and gallbladder (ab), Clifford H. Keene and Benjamin Copleman, June, 619

HERZOG, E. G.: Air arthrography in diagnosis of torn semilunar cartilage (ab), June, 624

HEUBLEIN, GILBERT W.: Roentgen diagnosis of traumatic lesions of the cervical spine (ab), Jan., 96

—See **BELL, JOSEPH C.**

HEYMAN, ALBERT. See **SHELDON, WALTER H.**

HEYMAN, J.: On improving the results of treatment in cancer of the collum of the uterus (ab), April, 437

HEYNS, O. S.: Studies in x-ray pelvimetry: an evaluation of pelvic radiography with a plea for simplicity (ab), March, 306

HINCHEY, JOHN J., and BICKEL, WILLIAM H.: Fracture of the atlas: review and presentation of data on eight cases (ab), April, 422

HIP

See also **ILIUM**

—different types of osteoarthritis and their connection with anatomical conditions. Does there exist any subluxation coxae acquisita? (ab), Ivan Hermodsson, April, 433

—osteochondritis dissecans of head of femur (ab), Ivan Hermodsson, June, 622

tuberculosis

—cystic tuberculosis in bone and joint; case (ab), Ingolfur Blöndal, June, 622

HIRSCH, EDWIN F., and RUSSELL, HOMER B.: Chronic exudative and indurative pneumonia due to inhalation of shellac (ab), March, 295

HODGKIN'S DISEASE

—salient clinical features and relative value of various methods of treatment based upon study of 319 cases (ab), Leonard B. Goldman and Abraham W. Victor, May, 544

—studies in Hodgkin's syndrome. IV. Therapeutic use of radioactive phosphorus (ab), Herman A. Hoster and Charles A. Doan, June, 629

HOLM, OLOF F.: Cinematography in cerebral angiography (ab), May, 531

HOLLAND, C. A.: Multiple carcinomas. Case of four consecutive primary carcinomas with apparent cure (ab), April, 438

HOLMGREN, BENGT S.: Case of fluoroscopically reduced sigmoid volvulus (ab), April, 428

Roentgen cinematography as a routine method (ab), June, 627

HOLT, JOHN F.: Roentgen diagnosis of pancreatic cyst, April, 329

HOOVER, WALTER B. See **ADAMS, RALPH**

HOPE, JOHN W. See **FABER, HAROLD K.**

HORMONES

—hormonal tumors of the adrenal (ab), George F. Cahill, Jan., 95

HORNER SYNDROME

—hereditary multiple exostosis. Review of literature and report of case with Horner-Bernard syndrome as complication (ab), Lloyd D. Fisher, Clare Parsons, and Cecil C. Cutting, June, 622

HOSPITALS

—hospital fluorography; its implications (letter to editor), J. Edwin Habbie, May, 523

—miniature chest films in general hospitals (ab), George N. Scatchard and Diana O. Duszynski, April, 425

HOSTER, HERMAN A., and DOAN, CHARLES A.: Studies in Hodgkin's syndrome. IV. Therapeutic use of radioactive phosphorus (ab), June, 629

HOWARD, J. CAMPBELL: Carcinoma of the prostate (ab), March, 315

HOWARD, JOHN T.: Experiences with the gastroscope over a period of six years (ab), March, 298

HOWORTH, M. BECKETT: Calcification of the tendon cuff of the shoulder (ab), Feb., 203

Echinococcosis of bone (ab), May, 539

HUDGINS, A. P.: X-ray studies in hysterosalpingography, using a new cannula (ab), Jan., 101

HUDSON, PERRY B., GAY, LENDALL C., and NEWMAN, HOWARD E.: Pneumothorax resulting from a dissecting gastric ulcer: review of literature and report of case (ab), April, 428

HUFF, FRANK M., and BOGER, WILLIAM P., Jr.: Renal hypoplasia with hydronephrosis and primary amenorrhea. Report of case (ab), June, 625

HUFFORD, A. RAY, and STONEHOUSE, G. G.: Orientation of the gastroscope by roentgenograms (ab), Jan., 94

—See **HARDT, LEO L.**

HUMERUS

—osteochondritis dissecans of the supratrochlear septum of humerus (ab), W. E. Cryslar and H. S. Morton, May, 540

—at upper end. Classification based on etiology of trauma (ab), Ernst Delne, Jan., 98

HURLER'S DISEASE. See **Lipochondrodystrophy**

HUSSEY, FRANK L.: Value of spot films in radiography of the gastro-intestinal tract (ab), March, 297

HUSSEY, HUGH H., and KATZ, SOL: Septic pulmonary infarction: report of eight cases (ab), March, 295

HYDRARTHROSIS

—roentgenographic appearance of temporomandibular hydrarthrosis, Arnold L. Bachman and Albert L. Bershon, March 251

HYDROCEPHALUS

—congenital absence of the septum pellucidum associated with internal hydrocephalus, William P. Savain, March, 270

—diagnosis and treatment of strictures of aqueduct of Sylvius (causing hydrocephalus) (ab), Walter E. Dandy, June, 612

HYDRONEPHROSIS

—primary carcinoma of ureter with special reference to hydronephrosis. Review of literature and report of unusual case (ab), Joseph A. Lazarus and Morris S. Marks, June, 626

HYMAN, A.: Renal lithiasis and its treatment (ab), March, 307

HYMAN, GEOFFREY: Case of pseudarthrosis following fractures of the lumbar transverse processes (ab), March, 303

HYPEREMIA

—reflex hyperemic deossifications regional to joints of the extremities, Alfred A. de Lorimier, William L. Minear, and Harold B. Boyd, March, 227

HYPERNEPHROMA. See **Kidneys, tumors**

HYPEROSTOSIS

—infantile cortical hyperostoses: preliminary report on a new syndrome (ab), John Caffey and William A. Silverman, May, 538

HYPOPHARYNX. See **Foreign Bodies, in air and food passages; Larynx**

HYSTEOSALPINGOGRAPHY. See **Fallopian Tubes; Pregnancy, complications**

I**ICELAND**

—rickets in Iceland (ab), Niels Dungal, June, 621

ILEITIS. See **Intestines**

ILEUM. See **Intestines; Intussusception**

ILIUM

—osteitis condensans ilii (ab), Hugh F. Hare and G. Edmund Haggart, May, 540

IMLER, ALLISON E., MEILSTRUP, DREW B., and BOGART, FRANKLIN B.: Primary Ewing's sarcoma of the spine, June, 597

INDUSTRY AND OCCUPATIONS

See also **Pneumoconiosis**

—attitude of industry toward x-ray examinations of chest (ab), C. D. Selby, May, 533

—intervertebral disc injury: analysis from an industrial standpoint (ab), Henry C. Marble and William A. Bishop, March, 302

—x-ray protection in industrial fluoroscopy, George C. Henny, Jan., 66

INFANTS

See also **Children**

—cardiac hypertrophy and extramedullary erythropoiesis in newborn infants of prediabetic mothers (ab), Herbert C. Miller, Feb., 199

—chronic stridor in early life due to persistent right aortic arch: report of 2 cases (ab), Harold K. Faber, John W. Hope, and Francis L. Robinson, Jan., 92

—congenital duodenal obstruction. Report of 6 cases and review of the literature, Friedrich G. Kautz, James R. Lisa, and Ernest Kraft, April, 334

—hypertrophic pyloric stenosis: roentgenologic differential diagnosis (ab), Russel F. Miller and Herman W. Ostrum, May, 537

—infantile cortical hyperostoses: preliminary report on new syndrome (ab), John Caffey and William A. Silverman, May, 538

—megacolon in newborn. Clinical and roentgenological study with special regard to pathogenesis (preliminary report) (ab), Th. Ehrenpreis, April, 429

—occurrence and significance of early periosteal proliferation in diaphyses of premature infants (ab), Nils Malmberg, April, 433

—pyopneumothorax in the first month of life with recovery: Two case reports (ab), G. P. Rosemond and H. T. Caswell, May, 534

—roentgen anatomy of skull in newborn infant, Samuel G. Henderson and Louise S. Sherman, Feb., 107

—roentgen therapy of hemangioma of larynx in infants (ab), H. H. Kasahach and C. P. Donlan, Feb., 208

—roentgenologic determination of heart volume in infants. Preliminary report (ab), Oliver Axén and John Lind, April, 426

—some practical hints on performance of urography on infants (ab), Harald Christiansen, June, 626

—stenosis of sigmoid in newborn (ab), W. R. Bagley and E. C. Bagley, April, 429

—tuberculous pleurisy with effusion in infancy (ab), Janet B. Hardy and Edwin L. Kendig, Jr., Jan., 89

—unusual bone lesions in an infant, probably osteitis tuberculosa multiplex cystoides, F. Y. Khoo and Y. Yang, March, 263

INFECTION

—problem of secondary infection in carcinoma of cervix, Manuel Garcia and Joseph V. Schlosser, May, 445

INTERVERTEBRAL DISKS. See **Spine**

INTESTINES

See also **Colon; Sigmoid**

—cellular dynamics in intestinal mucosa: effect of irradiation on epithelial maturation and migration (ab), Nathan B. Friedman, May, 537

—regional ileitis (ab), G. W. H. Schepers, Feb., 209

INTESTINES—cont.

- cancer
- malignant tumors of small intestine. Review of literature and report of 21 cases (ab), Kenneth Fraser, March, 300
- diverticula
- diverticulosis of jejunum and ileum, Max Ritvo and Paul J. Votta, April, 343
- epiploic appendages
- calcified appendices epiploicae as freely mobile bodies in abdominal cavity (a roentgen-diagnostically interesting subsidiary find) (ab), Olafio Morales, April, 429
- foreign bodies
- gallstone ileus (ab), Gordon McHardy and Donovan C. Browne, March, 301
- intestinal obstruction by gallstones (ab), Maurice Lee, Feb., 200
- hemorrhage
- pancreatic calculi as rare cause of hemorrhage: Report of case, George Crile, Jr. and Henry L. Jaffe, June, 586
- obstruction. See also Intestines, foreign bodies; Intussusception
- strangling obstruction of small bowel with special reference to cases with poor roentgen findings (ab), J. Frimann-Dahl, April, 428
- roentgenography
- case of sprue syndrome (ab), James Isbister, March, 300
- clinical significance of alteration of small intestinal pattern as demonstrated by x-ray (ab), Julian M. Ruffin, George J. Baylin, and David Cayer, March, 299
- Henoch's purpura: small intestinal changes. Case report, William H. Whitmore and Gerald M. Peterson, April, 373
- tuberculosis
- some cases in phthisics, with reference especially to prognosis (ab), S. B. Larsen, June, 618
- volvulus
- fluoroscopically reduced sigmoid volvulus; case (ab), Bengt S. Holmgren, April, 428
- periodic, spontaneously remittent volvulus and the symptoms in cases of colon elongatum (ab), Flemming Nørsgaard, June, 618

INTUSSUSCEPTION**IONIZATION CHAMBER.** See Roentgen Therapy, dosage**IRON**

- idiopathic pulmonary hemosiderosis (essential brown induration) (ab), Per Selander, Jan., 91
- iron oxide dust and the lungs of silver finishers (ab), A. I. G. McLaughlin, J. L. A. Grout, H. J. Barrie, and H. E. Harding, Feb., 196

IRVING, JAMES G. See SOULE, ARTHUR B., Jr.**ISBISTER, JAMES:** Case of Besnier-Boeck-Schaumann syndrome, or benign lymphogranulomatosis, with pneumothoraces (ab), Feb., 198**Case of sprue syndrome (ab), March, 300****ISCHIUM**

- epiphysitis of ischial tuberosity: case report (ab), Paul E. McMaster, May, 540

ISOHEMAGGLUTININS

- cold isohemagglutinins: their association with hemolytic anemia and multiple thromboses in primary atypical pneumonia. Brief review of clinical and laboratory problems involved (ab), William R. Platt and Charles S. Ward, Jr., March, 294

ISOTOPES, RADIOACTIVE. See Radioactivity**IVIE, JOS. McK.:** Congenital absence of the odontoid process.**Report of case, March, 268****—See ECHLIN, FRANCIS A.****J****JACKMAN, JAMES, and LUBERT, MORTIMER:** Significance of calcification in the ascending aorta as observed roentgenologically (ab), March, 310**JACOBS, LEWIS G.** See GILMORE, JOHN H.**JAFFE, HENRY L.:** Evaluation of roentgen therapy in filariasis (ab), March, 315**—See CRILE, GEORGE, Jr.****JAMES, C. C. MICHAEL:** Late bone lesions in caisson disease.**Three cases in submarine personnel (ab), June, 621****JANSSON, GÖSTA:** Roentgen treatment and the course of cure of giant cell tumour in the osseous system (10–12 years' cure) (ab), April, 438**JAPANESE-AMERICANS**

- incidence of tuberculosis in Japanese-Americans: a study of a homogeneous racial group (ab), H. E. Bass and G. D. Carlyle Thompson, May, 532

JAWS

- arthrography of mandibular joint (ab), Flemming Nørsgaard, April, 422
- roentgenographic appearance of temporomandibular dysfunction, Arnold L. Bachman and Albert L. Bershon, March, 251

- roentgenographic demonstration of concretions in the sub-mandibular glandular duct by use of intraoral films, George D. Monardo, Jan., 63

JEJUNUM. See Intestines**JENSEN, ANTON:** Dosis measurements in roentgen irradiation of the female pelvis (ab), June, 630**JENSEN, S. HOFFER:** Simple device for continuous control of roentgen-ray output (ab), June, 630**—, NIELSEN, JENS, and THAYSSSEN, V.:** Evaluation of different factors in rotation therapy (ab), May, 546**JOINTS****See also Elbow; Hip; Jaws; Knee; etc.**

- reflex hyperemic deossifications regional to joints of the extremities, Alfred A. de Lorimer, William L. Minear, and Harold B. Boyd, March, 227

diseases

- associated with acromegaly (ab), H. Waine, G. A. Bennett, and W. Bauc, March, 305
- chronic meliodosis. Case showing multiple lesions of bones, joints and lungs (ab), J. H. Maycr, May, 539

JORUP, SIGVARD: Case of chondrodystrophia congenita calcificans (ab), April, 434**JUBILEE ASSEMBLY,** Palestine Jewish Medical Association, Feb., 186**K****KANE, I. J.** See GRISHMAN, A.**KAPLAN, HENRY S.** See RIGLER, LEO G.**KAPLAN, IRA I.:** Roentgen therapy of arthritides (ab), May, 546**KARPEL, SAUL, WAGGONER, IRVING M., and McCOWN, OSWALD S., Jr.:** Primary atypical pneumonia: critical analysis of 500 cases (ab), Jan., 90**KASABACH, H. H., and DONLAN, C. P.:** Roentgentherapy of hemangioma of the larynx in infants (ab), Feb., 208**KATZ, SOL.** See HUSSEY, HUGH H.**KAUFMAN, JUSTUS:** Isolated myeloma in a fourteen year old boy (ab), June, 620**KAUTZ, FRIEDRICH G., LISA, JAMES R., and KRAFT, ERNEST:** Congenital duodenal obstruction. Report of six cases and review of the literature, April, 334**KEENE, CLIFFORD H., and COLEMAN, BENJAMIN:** Traumatic right diaphragmatic hernia: case with delayed herniation of liver and gallbladder (ab), June, 619**KEEVIL, R. F.** See ADAMSON, J. D.**KELLEY, CHARLES H.:** Enlarged parietal foramina and similar shadows seen in osteoporosis circumscripta: two cases, June, 601**KEMP, F. H.:** X-rays in diagnosis and localisation of gangrene (ab), Feb., 205**KEMP, L. A. W.:** New circuit with special applications in gamma-ray and x-ray dosimetry (ab), April, 439**KENDIG, EDWIN L., Jr.** See HARDY, JANET B.**KENDIG, TOM A.:** Pelviccephalometry, April, 391**KENNEDY, ROGER L. J.** See DOCKERTY, MALCOLM B.**KERNOHAN, J. W.** See COVENTRY, M. B.**KEROSENE**

- ingestion of kerosene complicated by pneumonia, pneumothorax, pneumopericardium, and subcutaneous emphysema (ab), Arnold F. Lavenstein, Feb., 195

KERR, H. DABNEY, and EINHORN, ROBERT A. J.: Results of irradiation of ovarian tumors (ab), Feb., 207**KERSHNER, DAVID, and KESSLER, LEON N.:** Solitary cyst of the kidney. Case report (ab), March, 310**KESSLER, LEON N.** See KERSHNER, DAVID**KESTON, ALBERT S.** See FOX, CHARLES L., Jr.**KHO, F. Y., and YANG, Y.:** Unusual bone lesions in an infant, probably osteitis tuberculosa multiplex cystoides, March, 263**KICKHAM, CHARLES J.:** Obstruction of the ureter in children (ab), April, 436**KIDNEYS****See also Aneurysm, renal; Hydronephrosis**

- arteriography in renal and abdominal conditions (ab), O. A. Nelson, Feb., 205
- renal osteodystrophy. Report of case of unusual pathogenesis (ab), John J. Castronuovo, Feb., 201
- tissue calcification and renal failure produced by massive dose vitamin D therapy of arthritis (ab), T. S. Danowski, A. W. Winkler, and J. P. Peters, June, 624

abnormalities

- anomalies of ureters and kidneys as observed by the radiologist (ab), Bernard H. Nichols, March, 308
- bilateral crossed renal ectopia: case report (ab), Charles M. Norfleet, Jr., May, 542
- crossed renal ectopia; case (ab), Quince B. Corny, March, 309
- duplication of right kidney pelvis and ureter with extravesical ureteral opening (ab), Russell J. Moe, March, 308
- ectopia: study of twenty-three cases (ab), Earl F. Nation, March, 309
- pathologic and anomalous conditions associated with duplication of renal pelvis and ureter (ab), Ruy Goyanna and Laurence F. Greene, May, 541
- renal hypoplasia with hydronephrosis and primary amenorrhea. Report of case (ab), Frank M. Huff and William P. Boger, Jr., June, 625
- unusual horseshoe kidney; case (ab), Henry Bodner and Max K. Moulder, Jan., 101

LOUGH, ROGER. See FORTIN
LOVE, J. GRAFTON. See EHNI, GEORGE

- LOW-BEER, BERTRAM V. A., and STONE, ROBERT S.:** Treatment of late post-irradiation ulcers with radon ointment, Feb., 149
- LOWMAN, ROBERT M., and DOFF, SIMON D.:** Arteriography for the demonstration of intracranial aneurysms (nb), Feb., 204
- and KUSHLAN, SAMUEL D.:** "The Krukenberg tumors." The roentgen and gastroenterological aspects of secondary ovarian carcinoma (nb), March, 306
- LUBERT, MORTIMER.** See JACKMAN, JAMES
- LÜBSCHITZ, KAREN:** Paget's disease on the nipple with special reference to its course and treatment (nb), May, 543
- LUNGS**
- influence of intra-alveolar pressure on normal and pathologic structure of lungs (nb), Nils Westermarck, April, 422
 - Paragonimus westermani: case report, Thomas H. Brem and Harold A. Colin, May, 511
 - production of growth by action of pituitary gland on vascular and hemopoietic systems: interrelationship between lungs and pituitary gland (nb), Robert C. Moehlig, June, 614
- abscess**
- acute putrid abscess (nb), Harold Neuhoef, Feb., 193
 - pulmonary abscess, acute and chronic (nb), Charles W. Lester, March, 295
- blood supply.** See also Aneurysm, pulmonary
- pulmonary embolism from obscure sources (nb), Aubrey O. Hampton, Andrew G. Prandoni, and John T. King, May, 534
 - roentgenographic pulmonary changes in periarteritis nodosa (ab), Tore Svanberg, Feb., 196
 - serial roentgenograms of chest in periarteritis nodosa as aid to diagnosis, with notes on pathology of pulmonary lesions (ab), A. Elkeles and L. E. Glynn, Feb. 196
- calcification**
- egg-shell calcifications in silicosis (ab), Allen D. Riemer, March, 295
- cancer**
- difficulties in differential diagnosis of bronchogenic carcinoma (ab), Robert G. Bloch, William E. Adams, Thomas F. Thornton, and J. Edmond Bryant, Feb., 198
 - early diagnosis of diseases of chest (value of mass surveys) (ab), Norman J. Wilson, Jan., 89
 - primary bronchogenic carcinoma (ab), Alton Ochsner, J. Leonard Dixon, and Michael DeBakey, Feb., 197
 - primary cancer, presumably arising from an old tuberculous cavern: case (ab), Gregers Thomsen and S. A. Chrom, June, 613
- cysts**
- so-called cyst, apparently subpleural interstitial airspace; case (ab) Jan Nordenskjöld, April, 420
- diseases**
- bronchography as diagnostic aid (ab), George S. McReynolds, Jr., and Fred W. Shelton, Jan., 88
 - chronic melioidosis. Case showing multiple lesions of bones, joints and lungs (ab), J. H. Mayer, May, 539
 - idiopathic pulmonary hemosiderosis (essential brown induration) (ab), Per Selander, Jan., 91
 - primary coccidioidomycosis: possible pediatric problem (ab), Ralph H. Kunststadter and Robert C. Pendergrass, Jan., 90
- dust diseases.** See Pneumoconiosis
- edema.** See Lungs, pathology
- emphysema.** See Emphysema
- fibrosis**
- acute interstitial fibrosis: case (ab), Howard Eder, Clinton V. Hawn, and George Thorn, Feb., 194
- hemorrhage**
- relapsing, diffuse bleedings or hemosiderosis pulmonum—a new clinical diagnosis (ab), Jan Waldenström, May, 533
- infarction**
- septic infarction: report of 8 cases (ab), Hugh H. Hussey and Sol Katz, March, 295
- pathology**
- Loeffler's syndrome associated with creeping eruption (cutaneous helminthiasis) (ab), D. O. Wright and Edwin M. Gold, June, 614
 - Loeffler's syndrome—eosinophilic pneumonia. Case report (ab), Sidney Seherlis, Feb., 197
 - transient focal pulmonary edema (ab), Carleton B. Peirce, Everett F. Crutchlow, Arthur T. Henderson, and Joseph W. McKay, May, 534
 - transient successive pulmonary infiltrations (Löfller's syndrome), Max Eichwald and William V. Singletary, March, 258
- roentgenography** See also Tuberculosis Pulmonary, mass roentgenologic surveys
- attitude of industry toward x-ray examinations of chest (ab), C. D. Selby, May, 533
 - changes due to mitral stenosis simulating those due to silicosis (ab), Henry W. Ryder and H. G. Reinecke, Jan., 91
 - disseminated calcified and bony nodules in lungs associated with mitral disease (ab), A. Grishman and I. J. Kane, April, 426
 - influence of intra-alveolar pressure on normal and pathologic structure (ab), Nils Westermarck, April, 422
 - tomography (ab), J. B. McDougall, Feb., 207
- tuberculosis.** See Tuberculosis, Pulmonary
- tumors**
- due to *Cryptococcus histolyticus* (blastomycosis) (ab), B. A. Dormer, J. Friedlander, F. I. Wiles, and F. W. Simson, June, 613
 - hamartoma (often called chondroma) (nb), John R. McDonald, Stuart W. Harrington, and O. Theron Clagett, Feb., 198
 - wounds and injuries
 - blast injury: clinical and radiological findings and their relation to certain symptoms (ab), G. R. Fearley, Feb., 197
 - concussion ("blast") in non-thoracic battle wounds (ab), Oswald Savage, Feb., 197
- LUTZ, WALTER G.** See WILSON, HUGH M.
- LYMPHANGIOMA.** See Tumors, angiomata
- LYMPHOBLASTOMA.** See Tumors, lymphoblastoma
- LYMPHOGRANULOMA.** See Sarcoidosis
- LYMPHOMA.** See Tumors, lymphoma
- LYON, ERNST:** Uncovertebral osteophytes and osteochondrosis of the cervical spine (ab), Feb., 202
- LYSHOLM, ERIK:** Fluorescent screen laminagraph (ab), March, 312
- M**
- MCCARTHY, PAUL V., and AKENHEAD, WALTON R.:** Pneumoconiosis due to cotton dust (byssinosis). Case report, Jan., 46
- See VAN DEMARK, R. E.**
- MCCOWN, OSWALD S., Jr.** See KARPEL, SAUL
- McCUNE, WM. S., and WOODHALL, BARNES:** Skull defect and herniation of cerebrium with absence of dura following head injury in adolescence (ab), Feb., 193
- MacDONALD, COLIN:** Hysterosalpingography in sterility (ab), Jan., 100
- McDONALD, JOHN R., HARRINGTON, STUART W., and CLAGETT, O. THERON:** Hamartoma (often called chondroma) of the lung (ab), Feb., 198
- McDOUGALL, J. B.:** Tomography (nb), Feb., 207
- McGAW, W. H., and WECKESSER, E. C.:** Pneumarthrograms of the knee. Diagnostic aid in internal derangements (ab), May, 540
- McGRIGOR, D. B., and SAMUEL, ERIC:** Radiology of war injuries. Part I. War wounds of abdomen (ab), Feb., 201
- Radiology of war injuries. Part II. War wounds of the urinary tract (ab), March, 310**
- Radiology of war injuries. Part III. War wounds of the chest (ab), April, 423**
- Radiology of war injuries. Part IV. War wounds of the head and neck (ab), May, 531**
- McGUFFIN, W. H.,** honored with degree of Doctor of Laws, May, 523
- McHARDY, GORDON, and BROWNE, DONOVAN C.:** Gallstone ileus (ab), March, 301
- McKAY, JOSEPH W.** See PEIRCE, CARLETON B.
- MacLACHLAN, E. A.** See TALBOT, NATHAN B.
- McLAUGHLIN, A. I. G., GROUT, J. L. A., BARRIE, H. J., and HARDING, H. E.:** Iron oxide dust and the lungs of silver finishers (ab), Feb., 196
- McMASTER, PAUL E.:** Epiphysitis of the ischial tuberosity: case report (ab), May, 540
- MacMILLAN, J. A.:** Problems in x-ray localization of foreign bodies in and about the eye (ab), Jan., 88
- McREYNOLDS, GEORGE S., Jr., and SHELTON, FRED W.:** Bronchography as a diagnostic aid in chest disease (ab), Jan., 88
- MADDOX, J. K.** See SEAR, H. R.
- MADONICK, M. J., and OLJENICK, IGNAZ W.:** Displacement of pineal gland with extradural hemorrhage (ab), Feb., 193
- MAGNUSSEN, WOLFGANG:** Radiographic manifestation of tuberculous salpingitis (ab), Feb., 204
- MAITLAND, D. G.:** Radiology of pelvic types and their obstetrical significance (ab), April, 435
- MALMBERG, NILS:** Occurrence and significance of early perosteal proliferation in the diaphyses of premature infants (ab), April, 433
- MANDEVILLE, FREDERICK B., and NELSON, CHARLES M.:** Wilms' tumor of kidney with five year survival following preoperative roentgen therapy and nephrectomy (ab), March, 314
- MANDIBLE.** See Jaws
- MANN, TREVOR E.:** Fatigue fracture of tibia. Three cases at a naval training establishment (ab), June, 625
- MANTZ, HARRY E.** See BACHMAN, ARNOLD L.
- MARBLE, HENRY C., and BISHOP, WILLIAM A.:** Inter-vertebral disc injury: analysis from an industrial standpoint (ab), March, 302
- MARCH FRACTURE.** See Fractures: Tibia, fractures
- MARKS, MORRIS S.** See LAZARUS, JOSEPH A.
- MARTIN, HAYES, and REESE, ALGERNON B.:** Treatment of bilateral retinoblastoma (retinal glioma) surgically and by irradiation. Report on progress (ab), May, 542
- MARTIN, JOHN W.:** Renal cyst, solitary (ab), Jan., 101
- MARUM, GOTTLIEB J.:** Roentgenographic observations in age atrophy and osteoporosis of the spine, March, 220
- MASS SURVEYS.** See Tuberculosis, Pulmonary
- MASTITIS.** See Breast, inflammation
- MAXILLARY SINUS**
- cancer**
- individualization in management of carcinoma (ab), Maurice F. Snitman, Jan., 103
- MAYER, EDGAR:** Light and x-ray therapy of tuberculosis (ab), March, 316
- and RAPPAPORT, ISRAEL:** Pulmonary emphysema—newer concepts (ab), March, 296

- MAYER, J. H.:** Chronic melioidosis. Case showing multiple lesions of bones, joints and lungs (ab), May, 539
- MAYERS, LAURENCE H.:** Bone regeneration following osteomyelitis (ab), Jan., 95
- MEDIASTINUM**
- defect of anterior mediastinum: successful surgical repair (ab), Robert E. Gross and James E. Lewis, Jr., March, 297
 - emphysema. See Emphysema
 - syphilis
 - occlusion of superior vena cava due to syphilitic mediastinitis. Collateral circulation after nineteen years (ab), Frederic D. Zeman, June, 615
- tumor**
- value of kymography for differential diagnosis between aneurysm of aorta and mediastinal tumor (ab), Bryan Fabricius, June, 615
- MEDICAL ECONOMICS**
- hospital fluorophotography: its implications (letter to editor), J. Edwin Habbe, May, 523
- MEGACOLON.** See Colon, dilatation
- MEILSTRUP, DREW B.** See IMLER, ALLISON E.
- MELAMED, A., and FELD, S. M.:** Luetic rectal stricture (ab), April, 429
- MELIOIDOSIS**
- chronic melioidosis. Case showing multiple lesions of bones, joints and lungs (ab), J. H. Mayer, May, 539
- MENDELSON, ERNST A.:** Hiatus hernia of the stomach as a source of gastro-intestinal bleeding, May, 502
- MENINGES.** See Dura Mater
- MENTAL DISEASES.** See Feeble-mindedness
- MEREDITH, W. J., and STEPHENSON, S. K.:** Use of radiographs for dosage control in interstitial gamma-ray therapy (ab), Feb., 211
- MERRILL, OLIVER E.** See ROBBINS, LAURENCE L.
- MESCHAN, ISADORE:** Spondylolisthesis: a commentary on etiology, and an improved method of roentgenographic mensuration and detection of instability (ab), Jan., 97
- METATARSUS**
- fractures
 - fatigue fracture; case, William E. Allen, Jr., March, 276
- MICORADIOGRAPHY**
- results of microradiography (ab), F. Bohatyrtscbuk, June, 627
- MILITARY MEDICINE**
- military photoroentgen technic employing optimum kilovolt (peak) principles (ab), Arthur W. Fuchs, April, 437
 - diseases. See also Tuberculosis, Pulmonary, in soldiers
 - duodenal ulcer in large army camp: incidence and statistical analysis (ab), Horace B. Loder and Stanley A. Kornblum, April, 428
 - non-disabling bronchiectasis, Archie Pine and T. B. Steinbausen, March, 237
- wounds and injuries**
- pulmonary concussion ("blast") in non-thoracic battle wounds (ab), Oswald Savage, Feb., 197
 - radiology of war injuries. Part I. War wounds of abdomen (ab), D. B. McGrigor and Eric Samuel, Feb., 201
 - radiology of war injuries. Part II. War wounds of the urinary tract (ab), D. B. McGrigor and Eric Samuel, March, 310
 - radiology of war injuries. Part III. War wounds of the chest (ab), D. B. McGrigor and Eric Samuel, April, 423
 - radiology of war injuries. Part IV. War wounds of the head and neck (ab), D. B. McGrigor and Eric Samuel, May, 531
 - value of routine roentgenographic studies of war injuries of head and neck (ab), Gilbert N. Haffly, Feb., 193
- MILLER, D. K.** See FARBER, JASON E.
- MILLER, EARL R.** See DAILEY, MORRIS E.
- MILLER, HERBERT C.:** Cardiac hypertrophy and extramedullary erythropoiesis in newborn infants of prediabetic mothers (ab), Feb., 199
- MILLER, J. E.:** Spontaneous renocolic fistula: report of case, May, 518
- MILLER, RUSSEL F., and OSTRUM, HERMAN W.:** Hypertrophic pyloric stenosis in infants: roentgenologic differential diagnosis (ab), May, 537
- MILLMAN, W. S.:** Osteochondritis dissecans of the supratrochlear septum (ab), June, 622
- MINEAR, WILLIAM L.** See de LORIMIER, ALFRED A.
- MINOR, HOWARD H.** See GROSSMAN, J. W.
- MITRAL VALVE**
- dextrocardia with situs inversus complicated by chronic rheumatic nortic and mitral endocarditis (ab), George W. Parson, June, 616
 - disseminated calcified and bony nodules in lungs associated with mitral disease (ab), A. Grishman and I. J. Kanc, April, 426
 - evaluation of teleroentgenographic mensuration and cardiac roentgenoscopy in diagnosis of early mitral valve disease (ab), Bernard S. Epstein, Jan., 93
 - pulmonary roentgenographic changes due to mitral stenosis simulating those due to silicosis (ab), Henry W. Ryder and H. G. Reinecke, Jan., 91
 - roentgen findings in intracardiac and particularly perimitral calcifications (ab), Hanning Odqvist, April, 426
- MOE, RUSSELL J.:** Duplication of right kidney pelvis and ureter with extravascular ureteral opening (ab), March, 308
- MOEHLIG, ROBERT C.:** Production of growth by the action of the pituitary gland on the vascular and hemopoietic systems: interrelationship between the lungs and the pituitary gland (ab), June, 614
- MONARDO, GEORGE D.:** Roentgenographic demonstration of concretions in the submandibular glandular duct by use of intraoral films, Jan., 53
- MONFORT, JOHN, POLAYES, SILIK H., and SORKIN, REUBEN:** Infantile dwarfism (encephalomyelitis) in siblings (ab), June, 621
- MONTGOMERY, THADEUS L.** See BEECHAM, CLAYTON T.
- MOONEY, A. CRAIG:** Disc lesions in relation to pain (ab), March, 302
- MOORE, ROBERT D.:** Conservative management of adolescent slipping of the capital femoral epiphysis (ab), Jan., 99
- MORALES, OLALLO:** Calcified appendices epiploicae as freely mobile bodies in the abdominal cavity (a roentgen-diagnostically interesting subsidiary find) (ab), April, 429
- MORGAN, RUSSELL H.:** Automatic exposure control in photo-fluorography (ab), Feb., 206
- See LEWIS, IRA
- MORRISON, M. C.:** Radiological findings in lesser sac effusions (ab), April, 430
- MORTON, H. S.** See CRYSLER, W. E.
- MOULDER, MAX K.** See BODNER, HENRY
- MOUTH**
- cancer
 - necrotizing bronchopneumonia: its relation to radiation therapy of cancer of oral cavity (ab), Lauren V. Ackerman, H. M. Wiley, and David V. LeMone, Jan., 103
 - treatment with radium bearing moulds (ab), Kurt Wiener, Jan., 103
- MOVITT, E. R.:** Spontaneous pneumothorax as a complication of pneumonia in adults (ab), March, 295
- MUCOCLE.** See Frontal Sinus
- MULTANGULAR BONE.** See Wrist
- MURBACH, C. F., LEWISON, E. F., and DEIBERT, G. A.:** Lymphangioma of the abdomen. An unusual case (ab), May, 538
- MURPHEY, FRANCIS.** See WHITELEATHER, J. E.
- MURPHY, GEORGE E.** See SISSON, JOHN H.
- MUSCLES**
- case of polymyositis treated with roentgen rays (ab), Hugo Ahlborn, March, 316
 - congenital absence of pectoralis major (ab), Eric Samuel, Feb., 203
- MYCOSIS FUNGOIDES**
- roentgen ray therapy (ab), Oscar L. Levin and Howard T. Behrman, March, 316
- MYEOGRAPHY.** See Spinal Canal Roentgenography; Spine, intervertebral disks
- MYELOMA.** See Tumors, myeloma
- MYELOMALACIA.** See Spinal Cord
- MYOCARDIUM.** See Heart
- MYOSITIS**
- case of polymyositis treated with roentgen rays (ab), Hugo Ahlborn, March, 316
- N**
- NACHLAS, I. WILLIAM, and OLPP, JOHN L.:** Para-articular calcification (Pellegrini-Stieda) in affections of the knee (ab), June, 623
- NALLS, WALTER L.:** Pitfalls in the diagnosis of atypical pneumonia (ab), Feb., 195
- NASOPHARYNX**
- cancer
 - myelomalacia of cervical portion of spinal cord, probably the result of roentgen therapy (of lymphoepithelioma) (ab), Lewis D. Stevenson and Robert E. Eckhardt, Jan., 105
 - roentgen treatment of malignant tumors (ab), Jens Nielsen, June, 627
- NATHANSON, LOUIS.** See SELIGMAN, BERNARD
- NATION, EARL F.:** Renal ectopia. Study of twenty-three cases (ab), March, 309
- NAVAL MEDICINE**
- fatigue fracture of tibia. Three cases at naval training establishment (ab), Trevor P. Mann, June, 625
 - silicosis in foundries of gun factory (ab), Edwards M. Riley, Robert W. Butler, and Sidney Goren, Jan., 91
- NECK**
- wounds and injuries
 - radiology of war injuries. Part IV. War wounds of the head and neck (ab), D. B. McGrigor and Eric Samuel, May, 531
 - value of routine roentgenographic studies of war injuries of the head and neck (ab), Gilbert N. Haffly, Feb., 193
- NECROSIS.** See Radiations, injurious effects
- NELSON, CHARLES M.** See MANDEVILLE, FREDERICK B.
- NELSON, O. A.:** Arteriography in renal and abdominal conditions (ab), Feb., 205
- NERVES**
- protrusions of disks and nerve compression in lumbar region (ab), K. Lindblom, May, 540
- NEUHAUSER, EDWARD B. D.:** Roentgen changes associated with pancreatic insufficiency in early life, April, 319
- NEUHOF, HAROLD:** Acute putrid abscess of the lung (ab), Feb., 193
- NEUROFIBROMATOSIS**
- diffuse neurofibromatosis of conjunctiva. Report of case, with involving the bulbar conjunctiva, bodily asymmetry lesions of the skeletal system and skin, bodily asymmetry and intracranial involvement (ab), Francisco Pérez Alende, Jan., 87
 - skeletal lesions (ed), June, 604

NEUTRONS. See Radioactivity**NEVI**

See also Tumors, angioma

- slowly developing non-pigmented nevo-epithelioma presenting a non-characteristic histologic picture (ab), Jens M. Nordentoft, June, 627

NEWMAN, ELLIOTT V. See **SISSON, JOHN H.****NEWMAN, HOWARD E.** See **HUDSON, PERRY B.****NICHOLAS, F. G.:** Review of three gastric cases with positive radiological and negative laparotomy findings (ab), March, 299**NICHOLS, BERNARD H.:** Anomalies of ureters and kidneys as observed by the radiologist (ab), March, 308**NICKERSON, SAMUEL H.:** Pathology of anomalies found in knee joints (nb), Jan., 99**NIELSEN, HOWARD:** Determination of the dose in circular phantoms under rotary irradiation (ab), June, 630**NIELSEN, JENS:** Roentgen treatment of malignant tumors of the nasopharynx (ab), June, 627—See **JENSEN, S. HOFFER****NØRGAARD, FLEMMING:** Arthrography of mandibular joint (ab), April, 422

- Periodic, spontaneously remittent volvulus and the symptoms in cases of colon elongatum (ab), June, 618

NORDENSKJÖLD, JAN: Case of so-called lung cyst, apparently a subpleural interstitial airspace (ab), April, 426**NORDENTOFT, JENS M.:** Slowly developing non-pigmented nevo-epithelioma presenting a non-characteristic histologic picture (ab), June, 627**NORFLEET, CHARLES M., Jr.:** Bilateral crossed renal ectopia: case report (ab), May, 542**NORGORE, MARTIN:** Clinical anatomy of the vertebral veins (ab), Feb., 204**NOSE**

- bilateral congenital atresia of choanae (ab), Daniel D. Klaff, March, 294

- congenital atresia of posterior nares. Description of techniques used in meeting the operative difficulties and report of case (ab), Harold M. E. Boyd, March, 293

NUCLEINS

- effects of roentgen radiation on the thymonucleic acid content of transplantable mammary carcinomas (ab), Robert E. Stowell, Jan., 106

NUTTALL, JOHN R. See **CARLING, E. ROCK****NYGAARD, K. K.** See **LEWITAN, ALEXANDER****O****OAHU**

- tuberculosis survey of food handlers on Oahu (ab), Joseph E. Ferkany and Richard K. C. Lee, May, 533

OBITUARIES

- Bryan, Lloyd, April, 414
- Finn, Fauntleroy, Jan., 82
- Gian-Franceschi, Joseph S., May, 524
- Swope, Opie W., May, 524
- Welch, Cecil Charles, April, 414

OCHSNER, ALTON, DIXON, J. LEONARD, and DeBAKEY, MICHAEL: Primary bronchiogenic carcinoma (ab), Feb., 197**ODONTOID PROCESS**

- congenital absence: case, Jos. McK. Ivie, March, 268

ODQVIST, HENNING: Studies on the roentgen findings in intracardiac and particularly perimittal calcifications (ab), April, 426**OINTMENT**

- new method of making radon ointment, L. Cardenas and J. L. Weatherwax, April, 381
- treatment of late post-irradiation ulcers with radon ointment, Bertram V. A. Low-Beer and Robert S. Stone, Feb., 149
- treatment of post-irradiation ulcers by radon ointment (ab), A. G. S. Cooper and D. F. Robertson, Feb., 212

OLIN, HARRY A.: Excretion urography, its value in the diagnosis of renal diseases (ab), March, 307**OLJENICK, IGNAZ W.** See **MADONICK, M. J.****OLPP, JOHN L.** See **NACHLAS, I. WILLIAM****OLSSON, OLLE:** Method for radiography of superficial layers (superficial tomography by vertical tube motion) (ab), March, 312**OPPENHEIMER, ALBERT:** Diseases of the vertebral column: roentgenologic analysis (ab), Feb., 202**ORCHIECTOMY.** See **Castration****OSBORN, S. B., TAVENER, DIANA R., and FARMER, F. T.:** Dosage distribution in the treatment of ringworm by x-rays (ab), March, 316**OSTEITIS**

- osteitis condensans ilii (ab), Hugh F. Hare and G. Edmund Haggart, May, 540

deformans

- “metastatic” calcification in soft tissues of legs in osteitis deformans: case report (ab), Bernard Seligman and Louis Nathanson, June, 624

- tuberculous. See **Bones, tuberculosis**

OSTEOARTHRITIS

- march fracture of the articular surface of the tibia and its relation to osteoarthropathy, Joseph Levitin, March, 273

OSTEOCHONDRITIS

- subcostal swelling of soft tissues (ab), Knut Lindblom, April, 434

- uncovertebral osteophytes and osteochondrosis of cervical spine (ab), Ernst Lyon, Feb., 202

dissecans

- etiology (ab), S. Ribbing, April, 433
- of head of femur (ab), Ivan Hermodsson, June, 622
- of supratoracellar septum (ab), W. S. Millman, June, 622
- of supratoracellar septum of humerus (ab), W. E. Cryslar and H. S. Morton, May, 540

OSTEOCHONDROSIS

- incidence (nb), S. A. Chrom, June, 622

OSTEODYSTROPHY. See **Dwarfism, renal****OSTEOMA.** See **Tumors, osteoma****OSTEOMYELITIS**

- See also **Clavicle**

- bone regeneration following osteomyelitis (ab), Laurence H. Mayers, Jan., 95

- osteomyelitis caused by granuloma inguinale: report of case with cultivation of Donovan body in yolk sac of developing chick embryo (ab), Walter H. Sheldon, Ben R. Thebaut, Albert Heyman, and Margaret J. Wall, June, 619

OSTEOPOROSIS. See **Cranium; Spine****OSTEOSCLEROSIS**

- osteomyelosclerosis (ab), G. A. Landoff, May, 540

OSTRUM, HERMAN W. See **MILLER, RUSSEL F.****OVARY**

- clinical effects of surgical and x-ray castration in mammary cancer (ab), Frank E. Adair, Norman Treves, Joseph H. Farrow, and Isabel M. Scharnagel, March, 312

cancer

- carcinoma treated preoperatively with deep x-ray. Report of 3 cases (ab), Thomas J. Parks, March, 314

- effect of deep x-rays on peritoneal metastases (ab), James Watt, Jan., 104

- results of irradiation (ab), H. Dabney Kerr and Robert A. J. Einstein, Feb., 207

tumors

- dyserginoma of ovary with widespread metastases*, Eugene P. Pendergrass and Joseph Selman, April, 377

- “Krukenberg tumors.” Roentgen and gastroenterological aspects of secondary ovarian carcinoma (ab), Robert M. Lowman and Samuel D. Kushian, March, 306

OVERGAARD, KRISTIAN: On Bechterew's disease from the roentgenologic point of view (ab), June, 623**OXYCEPHALY.** See **Acrocephaly****P****PÁEZ ALLENDE, FRANCISCO:** Diffuse neurofibromatosis (von Recklinghausen's disease) involving the bulbar conjunctiva. Report of case, with lesions of skeletal system and skin, bodily asymmetry and intracranial involvement (ab), Jan., 87**PAGET'S DISEASE.** See **Breast; Osteitis deformans****PALESTINE JEWISH MEDICAL ASSOCIATION,** Jubilee Assembly, Feb., 186**PANCREAS**

- aberrant pancreatic tissue as roentgenologic problem (ab), George J. Baylin, Jan., 94

calculi

- as rare cause of intestinal hemorrhage. Report of case, George Crile, Jr. and Henry L. Jaffe, June, 586

cysts

- roentgeo diagnosis, John F. Holt, April, 329

diseases

- cystic fibrosis (ed), April, 412
- roentgen changes associated with pancreatic insufficiency in early life, Edward B. D. Neuhauser, April, 319

PANTOPAQUE. See **Spinal Canal Roentgenography; Spine, intervertebral disks****PARACHUTE FRACTURE.** See **Tibia, fractures****PARAGONIMUS**

- Paragonimus westermanii*: case report, Thomas H. Brem and Harold A. Cohn, May, 511

PARALYSIS**phrenic**

- mechanical paralysis of left hemidiaphragm complicating collapse therapy in pulmonary tuberculosis (ab), Oscar Feinsilver, Feb., 194

PARIETAL BONE

- enlarged parietal foramina and similar shadows seen in osteoporosis circumscripta: 2 cases, Charles H. Kelley, June, 601

PARKS, THOMAS J.: Carcinoma of the ovary treated preoperatively with deep x-ray. Report of three cases (ab), March, 314**PARSON, GEORGE W.:** Dextrocardia with situs inversus complicated by chronic rheumatic aortic and mitral endocarditis (ab), June, 616**PARSONS, CLARE.** See **FISHER, LLOYD D.****PATERSON, EDITH.** See **GRAY, L. H.****PAUL, L. W., and ERICKSON, T. C.:** Observations on the presence of subdural gas after pneumoencephalography, Feb., 139

- See **FOHLE, ERNST A.**

PEACHER, WILLIAM G., and ROBERTSON, ROBERT C. L.: Pantoopaque myelography: results, comparison of contrast media, and spinal fluid reaction (ab), March, 303**PEAKE, JOHN D.:** Radiation therapy in uterine fibroids (ab), June, 629**PEIRCE, CARLETON B., CRUTCHLOW, EVERETT J., HENDERSON, ARTHUR T., and McKAY, JOSEPH P.:** Transient focal pulmonary edema (ab), May, 5**PELEGRINI-STIEDA DISEASE.** See **Femur**

PELVIS

- dosis measurements in roentgen irradiation of female pelvis (ab), Anton Jensen, June, 630
- measurement
- pelvic x-ray measurements and pelvic contraction (ab), Eric W. Frecker, April, 435
- pelvicephalometry, Tom A. Kendig, April, 391
- radiology of pelvic types and their obstetrical significance (ab), D. G. Maitland, April, 435
- studies in x-ray pelvimetry: evaluation of pelvic radiography with a plea for simplicity (ab), O. S. Heyns, March, 306

roentgenography

- diagnosis of space-restricting processes in small pelvis (ab), Lennart Wallden, April, 430

PENDERGRASS, EUGENE P., and LEOPOLD, SIMON S.:

- benign pneumoconiosis (ab), Feb., 195
- and SELMAN, JOSEPH: Dysgerminoma of the ovary with widespread metastases, April, 377

PENDERGRASS, ROBERT C.: Cardiac changes in arteriovenous fistula (ab), March, 297

- See KUNSTADTER, RALPH H.

PENIS

- plastic induration (ab), K. Schourup, Feb., 210

PENMAN, A. CLARK. See EDWARDS, PETER W.**PENTOTHAL**

- roentgenologic examination of stomach with patient under sodium pentothal anesthesia (ab), H. E. Plenge and J. N. Ross, Jan., 94

PEPTIC ULCER

- duodenal ulcer in large army camp: incidence and statistical analysis (ab), Horace B. Loder and Stanley A. Kornblum, April, 428
- gastric and duodenal ulcers in infancy and childhood (ab), Edward J. Donovan and Thomas V. Santulli, Jan., 93
- inflammatory lesions of upper gastrointestinal tract (ab), A. H. Aaron, March, 298
- pneumothorax resulting from dissecting gastric ulcer: review of literature and report of case (ab), Perry B. Hudson, Lendall C. Gay, and Howard E. Newman, April, 428
- short esophagus (thoracic stomach) and its association with peptic ulceration and cancer (ab), D. W. Smithers, May, 536
- ulcer of second part of duodenum (ab), P. T. Crymble, March, 299

PERIARTERITIS NODOSA

- roentgenographic pulmonary changes (ab), Tore Svanberg, Feb., 196
- serial roentgenograms of chest in periarteritis nodosa as an aid to diagnosis, with notes on pathology of pulmonary lesions (ab), A. Elkeles and L. E. Glynn, Feb., 196

PERICARDIUM

- silicosis of pericardium. Case report (ab), Marguerite G. Stemmerman, March, 297

PERIOSTEUM

- occurrence and significance of early periosteal proliferation in diaphyses of premature infants (ab), Nils Malmberg, April, 433

PERITONEUM

- radiological findings in lesser sac effusions (ab), M. C. Morrison, April, 430
- cancer
- effect of deep x-rays on peritoneal metastases of ovarian carcinoma (ab), James Watt, Jan., 104

PES PLANUS. See Foot, flat**PETERS, J. P.** See DANOWSKI, T. S.**PETERSON, GERALD M.** See WHITMORE, WILLIAM H.**PETROLEUM PRODUCTS**

- ingestion of kerosene complicated by pneumonia, pneumothorax, pneumopericardium and subcutaneous emphysema (ab), Arnold F. Lavenstein, Feb., 195

PFAHLER, G. E.: Treatment of hemangioma, Feb., 159**PHARYNX**

- See also Nasopharynx

cancer

- roentgen diagnosis of malignant tumors within boundary region between pharynx and esophagus (ab), Åke Åkerlund and Solve Welin, April, 422

PHILIP, J. F. See FOWLER, A.**PHOSPHORUS**

- radioactive. See Radioactivity

PHOTOROENTGENOGRAPHY. See Recruits; Roentgen Rays, Tuberculosis, Pulmonary, mass roentgenologic surveys**PHTHISIS.** See Tuberculosis, Pulmonary**PIGMENTATION**

- Albright's syndrome (polyostotic fibrous dysplasia with cutaneous pigmentation in both sexes and gonadal dysfunction in females) (ab), Malcolm B. Dockerty, Ralph K. Chormley, Roger L. J. Kennedy, and David G. Pugh, April, 433

PINEAL GLAND

- displacement of pineal gland with extradural hemorrhage (ab), M. J. Madonick and Ignaz W. Ojienick, Feb., 193

PISZCZEK, EDWARD A.: Tuberculosis, a new post war public health problem (ab), April, 425**PITUITARY BODY**

- production of growth by action of pituitary gland on vascular and hemopoietic systems: interrelationship between lungs and pituitary gland (ab), Robert C. Moehlig, June, 614

PLASMA CELLS. See Tumors, myeloma**PLASMOCYTOMA.** See Bones, marrow

- PLATT, WILLIAM R., and WARD, CHARLES S., Jr.:** Cold isohemagglutinins: their association with hemolytic anemia and multiple thromboses in primary atypical pneumonia. Brief review of the clinical and laboratory problems involved (ab), March, 294

PLENGE, H. E., and ROSS, J. N.: Roentgenologic examination of the stomach with patient under sodium pentothal anesthesia (ab), Jan., 94**PLEURISY**

- associated with primary atypical pneumonia: roentgenographic and clinical study (ab), Arnold L. Bachman, Nathan O. Sara, and Harry E. Mantz, Jan., 90

tuberculous

- pleurisy with effusion in infancy (ab), Janet B. Hardy and Edwin L. Kendig, Jr., Jan., 89

PLUMMER-VINSON SYNDROME. See Deglutition**PNEUMARTHROGRAMS.** See Knee**PNEUMOCONIOSIS**

- benign pneumoconiosis (ab), Eugene P. Pendergrass and Simon S. Leopold, Feb., 195
- clinical physiological observations on welders with pulmonary siderosis and foundry men with nodular uncomplicated silicosis (ab), Norbert Enzer, Ernst Simonson, and A. M. Evans, May, 534
- discussion on modern conceptions of industrial lung disease (ab), Charles L. Sutherland, Richard Fawcitt, and John Craw, June, 612
- due to cotton dust (byssinosis); case report, Paul V. McCarthy and Walton R. Akenhead, Jan., 46
- egg-shell calcifications in silicosis (ab), Allen D. Riemer, March, 295
- iron oxide dust and the lungs of silver finishers (ab), A. I. G. McLaughlin, J. L. A. Grout, H. J. Barrie, and H. E. Harding, Feb., 196
- observations on pulmonary disease in graphite workers (ab), Lasar Dunner, Feb., 196
- pulmonary roentgenographic changes due to mitral stenosis simulating those due to silicosis (ab), Henry W. Ryder and H. C. Reineke, Jan., 91
- roentgenology of massive conglomerate lesions of silicosis (ab), Mortimer R. Camiel, April, 425
- silicosis in foundries of naval gun factory (ab), Edwards M. Riley, Robert W. Butler, and Sidney Goren, Jan., 91
- silicosis of the pericardium. Case report (ab), Marguerite G. Stemmerman, March, 297

PNEUMOENCEPHALOGRAPHY. See Brain, roentgenography**PNEUMONIA**

- Loeffler's syndrome—eosinophilic pneumonia. Case report (ab), Sidney Scherlis, Feb., 197
- tularemia pneumonia. Review of American literature and report of 15 additional cases (ab), Byron M. Stuart and Roscoe L. Pullen, June, 614

atypical

- cold isohemagglutinins: their association with hemolytic anemia and multiple thromboses in primary atypical pneumonia. Brief review of clinical and laboratory problems involved (ab), William R. Platt and Charles S. Ward, Jr., March, 294
- pitfalls in diagnosis of atypical pneumonia (ab), Walter L. Nalls, Feb., 195
- pleuritic involvement associated with primary atypical pneumonia: roentgenographic and clinical study (ab), Arnold L. Bachman, Nathan O. Sara, and Harry E. Mantz, Jan., 90

- pneumococcal pneumonia resembling primary atypical pneumonia (ab), E. Racker, S. P. Rose, and A. O. Tumen, Feb., 195

- primary atypical pneumonia: critical analysis of 500 cases (ab), Saul Karpel, Irving M. Waggoner, and Oswald S. McCown, Jr. (ab), Jan., 90

- primary pneumonia of unknown cause (ab), Robert C. Schmitz, Feb., 195

complications and sequelae

- obstructive pulmonary emphysema associated with pneumonia in childhood (ab), Jerome S. Leopold and Emil A. Kratzman, May, 534

- spontaneous pneumothorax as a complication in adults (ab), E. R. Movitt, March, 295

diagnosis

- pneumococcal pneumonia resembling primary atypical pneumonia (ab), E. Racker, S. P. Rose, and A. O. Tumen, Feb., 195

lipid

- chronic exudative and indurative pneumonia due to inhalation of shellac (ab), Edwin F. Hirsch and Homer B. Russell, March, 295

- ingestion of kerosene complicated by pneumonia, pneumothorax, pneumopericardium, and subcutaneous emphysema (ab), Arnold F. Lavenstein, Feb., 195

PNEUMOPERICARDIUM

- ingestion of kerosene complicated by pneumonia, pneumothorax, pneumopericardium, and subcutaneous emphysema (ab), Arnold F. Lavenstein, Feb., 195

PNEUMOTHORAX

- See also Tuberculosis, Pulmonary
- Besnier-Boeck-Schaumann syndrome, or benign lymphogranulomatosis, with pneumothoraces; case (ab), James Isbister, Feb., 198

- ingestion of kerosene complicated by pneumonia, pneumothorax, pneumopericardium, and subcutaneous emphysema (ab), Arnold F. Lavenstein, Feb., 195

PNEUMOTHORAX—cont.

- resulting from dissecting gastric ulcer: review of literature and report of case (ab), Perry B. Hudson, Lendall C. Gay, and Howard E. Newman, April, 428
- spontaneous pneumothorax as a complication of pneumonia in adults (ab), E. R. Movitt, March, 295

POHLE, ERNST A., and CLARK, ELIZABETH A.: Multiple cavernous hemangioma of the skin, brain and skeleton: report of case treated by roentgen rays and observed for 7½ years (ab), March, 315

—, **PAUL, LESTER W., and CLARK, ELIZABETH A.:** Roentgentherapy of Boeck's sarcoid (ab), Feb., 208

POLAYES, SILIK H. See **MONFORT, JOHN**

POLGAR, F.: Nursing—n source of error in cholecystography (ab), May, 538

POLLARD, H. MARVIN, and COOPER, RALPH R.: Hyper-trophic gastritis simulating gastric carcinoma (ab), April, 427

POLYCYTHEMIA VERA

- radioactive phosphorus in treatment of polycythemia vera. Results and hematologic complications (ab), Byron E. Hall, Charles H. Watkins, Malcolm M. Hargraves, and Herbert Z. Giffin, May, 545

POLYGRAPH

- a simple polygraph, E. Wynne Egbert and Alfred G. Fuller, June, 594

PORTMANN, U. V., and LOUGH, ROGER: Roentgen therapy for acute encephalitis (ab), April, 439

PRANDI, ANDREW G. See **HAMPTON, AUBREY O.**

PRATT, EDWARD L. See **TALBOT, NATHAN B.**

PREGNANCY

- complications
- bysterosalpingography as diagnostic aid in certain types of ruptured uteri (ab), Joseph B. Sheffery, Jan., 100

PRESENT, ARTHUR J.: Rheumatoid spondylitis, with special reference to early diagnostic criteria (ab), June, 622

PRIODAX. See Gallbladder, roentgenography

PROGERIA

- clinical, metabolic and pathologic studies on patient (ab), Nathan B. Tolbot, Allan M. Butler, Edward L. Pratt, E. A. MacLachlan, and J. Tannheimer, March, 303

PROSTATE

- cancer
- carcinoma (ab), Harold J. Ham, Jan., 105
- carcinoma (ab), J. Campbell Howard, March, 315

PROUTY, JAMES V.: Treatment of hemangiomas with roentgen rays (ab), June, 627

PSEUDARTHROSIS

- pseudarthrosis following fractures of lumbar transverse processes: case (ab), Geoffrey Hyman, March, 303

PUBLIC HEALTH

- tuberculosis, a new post war public health problem (ab), Edward A. Piszczek, April, 425

PURPERIUM

- roentgen therapy as an adjunct in management of acute postpartum mastitis (ab), Robert A. Harvey, Howard A. Spindler, and Andrew H. Dowdy, Feb., 209

PUGH, DAVID G. See **DOCKERTY, MALCOLM B.**

PULLEN, ROSCOE L. See **STUART, BYRON M.**

PURPURA

- Heoch's purpura: small intestinal change. Case report, William H. Whitmore and Gerald M. Peterson, April, 373

PYELOGRAPHY

- See also Kidneys
- administration of contrast medium in urography via the booe marrow (ab), Lennart Wallden, May, 541
- miliary tuberculosis after retrograde pyelography. Report of case (ab), Åke Lindbom, May, 541
- roentgen examination of the urinary tract with special reference to methods of examination and findings in individuals with testicular tumors (ab), Joseph C. Bell, Gilbert W. Heublein, and Howard J. Hammer, April, 435
- some practical hints on performance of urography on infants (ab), Harald Christiansen, June, 626
- subcutaneous urography (ab), Jacob H. Vastine, 2d, and Mary Frances Vastine, March, 307

PYLORUS

- hypertrophy and steosis
- in infants: roentgenologic differential diagnosis (ab), Russel F. Miller and Herman W. Ostrum, May, 537

PYOPNEUMOTHORAX

- in the first month of life with recovery. Two case reports (ab), G. P. Rosemond and H. T. Caswell, May, 534

Q

QUIMBY, EDITH H.: Protection against x-rays and gamma rays. Tolerance dose or tolerance intensity, Jan., 57

R

RABENS, J. I. See **HARDT, LEO L.**

RACKER, E., ROSE, S. P., and TUMEN, A. O.: Pneumococci pneumonia resembling primary atypical pneumonia (ab), Feb., 195

RADIATIONS

- See also Cathode Rays; Radium; Roentgen Rays
- injurious effects
- changes in uterus after eradication of endometrial adenocarcinoma by radiotherapy with particular reference to infarct-like radionecrotic plaque in lining (ab), John F. Sheehan, Herbert E. Schmitz, and Janet Towne, Feb., 212

- necrotizing bronchopneumonia: its relation to radiation therapy of cancer of oral cavity (ab), Lauren V. Ackerman, H. M. Wiley, and David V. LeMone, Jan., 103
- treatment of late post-irradiation ulcers with radon ointment, Bertram V. A. Low-Beer and Robert S. Stone, Feb., 149
- treatment of post-irradiation ulcers by radon ointment (ab), A. G. S. Cooper and D. F. Robertson, Feb., 212

RADIOACTIVITY

- action of neutrons on bacteria (ab), F. G. Spear, March, 318
- action of neutrons on developing rat retina (ab), F. G. Spear and K. Tausley, March, 317
- comparison of two levels of neutron and neutron irradiation of normal and lymphomatous mice, using radiophosphorus as an indicator of cellular activity, K. G. Scott, Feb., 173
- diagnostic use of radioactive cesium salt (ab), Gunnar Solne, Feb., 207
- effect of insoluble radiophosphorus (chromium phosphate) when applied interstitially in the treatment of adenocarcinoma of the mamma in mice (ab), Harry Allen, L. H. Hempelman, Jr., and Nathan A. Womack, March, 318
- mechanism of shock from burns and trauma traced with radiosodium (ab), Charles L. Fox, Jr., and Albert S. Keston, April, 440
- radioactive phosphorus in the treatment of polycythemia vera. Results and hematologic complications (ab), Byron E. Hall, Charles H. Watkins, Malcolm M. Hargraves, and Herbert Z. Giffin, May, 545
- radiology and atomic power (ed), May, 521
- research with radioactive isotopes in the treatment of leukemia (ab), Erik Lindgren, April, 438
- studies in Hodgkin's syndrome. IV. Therapeutic use of radioactive phosphorus (ab), Herman A. Hoster and Charles A. Doan, June, 629
- therapeutic use of radioactive phosphorus (ab), Shields Warren, May, 545
- treatment of leukemia with artificial radioactive sodium: preliminary report (ab), Jørgen E. Thygesen, Aage Vidhæk, and Irgens Villum, June, 630

RADIOLOGICAL SOCIETIES

- American Radium Society, June, 606
 - American Roentgen Ray Society, March, 286
 - Cleveland Radiological Society, Jan., 80
 - New England Roentgen Ray Society, June, 606
 - North Carolina Radiological Society, March, 286
 - officers and meeting dates, Jan., 83; Feb., 189; March, 288; April, 418; May, 527; June, 608
 - Orleans Parish Radiological Society, April, 414
 - Rocky Mountain Radiological Society, May, 523
 - Tennessee Radiological Society, June, 606
- RADIOLOGICAL SOCIETY OF NORTH AMERICA**
- announcement of annual meeting, April, 414
 - Lowell S. Goin, M.D., president of the Radiological Society of North America (ed), Jan., 77
 - presidential address, (ed), Lewis G. Allen, March, 282

RADIOLOGY

- radiology and atomic power (ed), May, 521

RADIOPHOSPHORUS. See Radioactivity**RADIOTHERAPY.** See Radium; Roentgen Rays**RADIUM**

- See also Radiations; Radon
- defects in roentgen tubes demonstrated by gamma-ray photographs (ab), Sven Beoner, April, 439
- effect of variations in the dose rate of gamma radiation on cell degeneration in frog tadpole (ab), A. Glucksmann, K. Tausley, and C. W. Wilsoo, March, 317
- human factors (in protection against gamma rays), Robert B. Taft, Jan., 65
- protection against x-rays and gamma rays: combined report of the Standardization Committees of the American Roentgen Ray Society and the Radiological Society of North America, Jan., 57
- protection measurements of lead-shielded radium, Carl B. Braestrup, April, 385
- technic for auto-radiographs of radium containers (ab), Dorothy F. Clephan, April, 439
- tolerance dose or tolerance intensity, Edith H. Quimby, Jan., 57
- injurious effects
- development of sarcoma in bone subjected to roentgen or radium irradiation (ab), C. Howard Hatcher, Feb., 211
- radiation injury, Robert S. Stone, Jan., 59
- therapy. See also under organs
- cancer treatment with radium bearing moulds (ab); Kurt Wiener, Jan., 103
- energy absorption (integral dose) in the trunk in the radium treatment of breast cancer by interstitial and surface applicator methods, C. W. Wilson, April, 364
- slide rule for determination of dosage from linear applicators (ab), G. Rudinger, May, 546
- use of radiographs for dosage control in interstitial gamma-therapy (ab), W. J. Meredith and S. K. Stephenson, Feb., 211

RADIUS

- See also Forearm fractures
 - delayed rupture of the extensor pollicis longus tendon following Colles fracture (ab), Donald E. Coburn, March, 304
- RADNER, STIG:** Roentgenological changes in lead poisoning in children (ab), March, 305

RADON

- new circuit with special applications in gamma- and x-ray dosimetry (ab), L. A. W. Kemp, April, 439

RADON—cont.

- new method of making radon ointment, L. Cardenas and J. L. Weatherwax, April, 381
- treatment of late post-irradiation ulcers with radon ointment, Bertram V. A. Low-Beer and Robert S. Stone, Feb., 149
- treatment of post-irradiational ulcers by radon ointment (ab), A. G. S. Cooper and D. F. Robertson, Feb., 212
- RANEY, R. BEVERLY:** Isthmus defects of the fifth lumbar vertebra (ab), Jan., 97
- RAPPAPORT, ISRAEL.** See **MAYER, EDGAR**
- v. RECKLINGHAUSEN'S DISEASE.** See **Neurofibromatosis**
- RECRUITS**
 - advantages of supplemental radiographic studies at time of induction (ab), A. C. Galluccio, Jan., 89
 - chest x-ray examination: analysis of disqualifying conditions found among 105,141 selectees (ab), Richard E. Kinzer, April, 424
 - in World War II (symposium) (ab), Council on Military Affairs and Public Health, American College of Chest Physicians, April, 424
 - pathological manifestations and anatomical variations in pre-enlistment chest roentgenograms (ab), F. G. Stuart, April, 424

RECTUM

- congenital malformations of anus and rectum: clinical study (ab), Eugene T. Dmytryk, March, 300
- cancer**
 - dose distribution in rotary irradiation of eccentrically situated axial field as basis for experiments with rotation treatment of cancer of rectum (ab), Paula Wissenberg, May, 546
- stricture.** See **Rectum, syphilis**
- syphilis**
 - luetic rectal stricture (ab), A. Melamed and S. M. Feld, April, 429

REED, B. P. See **REED, C. I.**

REED, C. I., and REED, B. P.: Evidence of the peripheral action of vitamin D from x-ray diffraction studies (ab), March, 318

REESE, ALGERNON B. See **MARTIN, HAYES**

REEVES, ROBERT J.: Round cell tumor of bone resembling Ewing's tumor (ab), March, 313

REINEKE, H. G. See **RYDER, HENRY W.**

REISNER, DAVID, and DOWNES, JEAN: Minimal tuberculous lesions of the lung (ab), March, 294

RENANDER, AXEL: Radiographic examination of a case of cancer of the thymus (ab), Feb., 199

REPASS, FRED G.: Cleidocranial dysostosis—report of case (ab), Jan., 96

RESPIRATORY TRACT

- See also **Bronchi; Lungs; etc.**
- tumors**
 - plasma cell tumors of upper part of respiratory tract (ab), Frederick A. Figi, Albert C. Broders, and Fred Z. Havens, May, 532

RETINA

- action of neutrons on developing rat retina (ab), F. G. Spear and K. Tansley, March, 317
- tumors**
 - treatment of bilateral retinoblastoma (retinal glioma) surgically and by irradiation. Report on progress (ab), Hayes Martin and Algernon B. Reese, May, 542

RETINOBLASTOMA. See **Retina, tumors**

REXFORD, W. K., and CONNOLLY, PAUL J.: Traumatic infarction of the kidney (ab), March, 308

RHEUMATIC FEVER

- dextrocardia with situs inversus complicated by chronic rheumatic aortic and mitral endocarditis (ab), George W. Parson, June, 616

RHEUMATISM. See **Arthritis; Rheumatic Fever**

RIBBING, S.: Etiology of osteochondrosis dissecans (ab), April, 433

RIBS

- subcostal swelling of soft tissues in osteochondritis (ab), Knut Lindblom, April, 434

RICHMOND, DAVID A.: Fatigue fracture of the fibula. Report on two cases (ab), Jan., 99

RICKETS

- effect of severe rickets in early childhood on skeletal development in adolescence (ab), Ethel C. Dunham and Herbert Thoms, May, 539
- evidence of peripheral action of vitamin D from x-ray diffraction studies (ab), C. I. Reed and B. P. Reed, March, 318
- in Iceland (ab), Niels Dungal, June, 621
- occurrence and significance of early periosteal proliferation in diaphyses of premature infants (ab), Nils Malmberg, April, 433

renal. See **Dwarfism**

RIEMER, ALLEN D.: Egg-shell calcifications in silicosis (ab), March, 295

RIGLER, LEO G., KAPLAN, HENRY S., and FINK, DANIEL L.: Pernicious anemia and the early diagnosis of tumors of the stomach (ab), April, 427

RILEY, EDWARDS M., BUTLER, ROBERT W., and GOREN, SIDNEY: Silicosis in foundries of naval gun factory (ab), Jan., 91

RINGWORM

- dosage distribution in treatment by x-rays (ab), S. B. Osborn, Diana R. Tavener, and F. T. Farmer, March, 316

—roentgen-ray treatment of tinea capitis (ab), Lester M. J. Freedman and Lawrence G. Beinhauer, April, 439

RINVIK, ROALD: A case of Klippel-Feil syndrome (congenital synostosis of the cervical vertebrae) (ab), Jan., 96

RITVO, MAX, and VOTTA, PAUL J.: Diverticulosis of the jejunum and ileum, April, 343

ROBBINS, LAURENCE L., AUB, JOSEPH C., COPE, OLIVER, COGAN, DAVID G., LANGOHR, JOHN L., CLOUD, R. W., and MERRILL, OLIVER E.: Superficial "burns" of skin and eyes from scattered cathode rays, Jan., 1

ROBERTSON, D. F. See **COOPER, A. G. S.**

ROBERTSON, J. M. See **WOLFE, H. R. I.**

ROBERTSON, ROBERT C. L. See **PEACHER, WILLIAM G.**

ROBIN, PERCIVAL A.: A simple apparatus for body section radiography (ab), Feb., 207

ROBINSON, FRANCIS L. See **FABER, HAROLD K.**

ROENTGEN RAYS

- See also **Cathode Rays; Radiations; Roentgen Therapy**
- evidence of peripheral action of vitamin D from x-ray diffraction studies (ab), C. I. Reed and B. P. Reed, March, 318
- microradiography (ab), F. Bohatyrtschuk, June, 627
- apparatus.** See also **Roentgen Rays, technic**
- defects in tubes demonstrated by gamma-ray photographs (ab), Sven Benner, April, 439
- fluorescent screen laminagraph (ab), Erik Lysholm, March, 312
- simple apparatus for body section radiography (ab), Percival A. Robin, Feb., 207
- simple device for continuous control of roentgen-ray output (ab), S. Hoefter Jensen, June, 630
- some observations on x-ray treatment cones, C. E. Eddy and D. J. Stevens, Feb., 176
- diagnosis**
 - latent period which elapses between onset of lesion and appearance of radiographic signs (ed), James F. Brailsford, Feb., 184
- effects**
 - cellular dynamics in intestinal mucosa: effect of irradiation on epithelial maturation and migration (ab), Nathan B. Friedman, May, 537
 - clinical effects of surgical and x-ray castration in mammary cancer (ab), Frank E. Adair, Norman Treves, Joseph H. Farrow, and Isabel M. Scharnagel, March, 312
 - comparison of two levels of roentgen and neutron irradiation of normal and lymphomatous mice, using radiophosphorus as indicator of cellular activity, K. G. Scott, Feb., 173
 - effects of colchicine and x-rays on onion root tips (ab), Michael Levine, Jan., 106
 - effects of roentgen radiation on thymonucleic acid content of transplantable mammary carcinomas (ab), Robert E. Stowell, Jan., 106
 - studies in vitro on cellular physiology. Effect of x-rays on survival of cells, Robert Schrek, April, 395

films. See **Roentgenograms**

fluoroscopy. See also **Roentgen Rays, protection against; Intestines, volvulus; etc.**

—hospital fluorophotography: its implications (letter to editor), J. Edwin Habbe, May, 523

injurious effects

- development of sarcoma in bone subjected to roentgen or radium irradiation (ab), C. Howard Hatcher, Feb., 211

—genetic injury, Paul S. Henshaw, Jan., 62

—implications from studies with physical carcinogens (nb), Paul S. Henshaw, April, 440

—myelomalacia of cervical portion of spinal cord, probably the result of roentgen therapy (ab), Lewis D. Stevenson and Robert E. Eckhardt, Jan., 105

—radiation injury, Robert S. Stone, Jan., 59

—tolerance dose or tolerance intensity, Edith H. Quimby, Jan., 57

physics

- condenser ionization chambers for measurement of x-rays in body cavities: physical problems in their design (ab), F. T. Farmer, April, 439

protection against

- human factors, Robert B. Taft, Jan., 65

—in industrial fluoroscopy, George C. Henry, Jan., 66

—in roentgenoscopy (ab), John F. Bacon and Eugene T. Leddy, June, 627

—materials and methods of protection, George Singer and George C. Laurence, Jan., 69

—protection against x-rays and gamma rays: combined report of the Standardization Committees of the American Roentgen Ray Society and the Radiological Society of North America, Jan., 57

stereoscopy

- value in mass radiography of chest, Ira Lewis and Russell H. Morgan, Feb., 171

technic. See also **Cinematography; Body Section Roentgenography; Kymography**

—automatic exposure control in photofluorography (ab), Russell H. Morgan, Feb., 206

—military photoroentgen technic employing optimum kilovolt (peak) principles (ab), Arthur W. Fuchs, April, 437

—so-called retarded or occult fractures. Significance of parallel projection in roentgen diagnosis of fractures, Benedict J. Toth, May, 475

ROENTGEN THERAPY.

See also **under diseases and organs**

—experiences with rotation therapy (ab), Lars Edling, April, 439

ROENTGEN THERAPY—cont.

- some observations on x-ray treatment cones, C. E. Eddy and D. J. Stevens, Feb., 176
- dosage
 - behavior of thimble chambers when used for measurement of very soft radiation (ab), J. A. Victoreen, Z. J. Atlee, and E. D. Trout, Feb., 211
 - condenser ionization chambers for measurement of x-rays in body cavities; physical problems in their design (ab), F. T. Farmer, April, 430
 - determination of dose in circular phantoms under rotary irradiation (ab), Howard Nielsen, June, 630
 - dose distribution in rotary irradiation of eccentrically situated axial field as basis for experiments with rotation treatment of cancer of rectum (ab), Paula Wissenberg, May, 546
 - dosis measurements in irradiation of female pelvis (ab), Anton Jensen, June, 630
 - evaluation of different factors in rotation therapy (ab), S. Hoefler Jensen, Jens Nielsen, and V. Thaysen, May, 546
 - new circuit with special applications in gamma- and x-ray dosimetry (ab), L. A. W. Kemp, April, 439
 - photographic methods applied to dosimetric problems (ab), G. Spiegler, Feb., 211
 - rate: symposium (ab), L. H. Gray, F. Ellis, G. C. Fairchild, and Edith Paterson, Feb., 210
 - standardization of technic (ab), Emil Ungar, Feb., 210
 - high voltage
 - carcinoma of ovary treated preoperatively with deep x-ray. Report of 3 cases (ab), Thomas J. Parks, March, 314
 - effect of deep x-rays on the peritoneal metastases of ovarian carcinoma (ab), James Watt, Jan., 104

ROENTGENOGRAMS

- simple polygraph, E. Wayne Egbert and Alfred G. Fuller, June, 594
- use of radiographs for dosage control in interstitial gamma-ray therapy (ab), W. J. Meredith and S. K. Stephenson, Feb., 211
- wet-film viewing room (ab), Leo H. Garland and Milo T. Harris, April, 437

RONALD, D. A.: Fatigue fracture (ab), May, 541

ROSE, S. P.: See RACKER, E.

ROSEMOND, G. P., and CASWELL, H. T.: Pyopneumothorax in the first month of life with recovery. Two case reports (ab), May, 534

ROSENDAL, THOMAS: On reticulum cell sarcoma in the bones (ab), June, 620

ROSENTHAL, D. B.: See WILLIS, R. A.

ROSS, J. N.: See PLENCE, H. E.

RUDINGER, G.: Slide rule for determination of dosage from linear radium applicators (ab), May, 546

RUDSTROM, PAUL: Cholangiograms in intrahepatic processes (ab), March, 301

RUFFIN, JULIAN M., BAYLIN, GEORGE J., and CAYER, DAVID: Clinical significance of alteration of the small intestine pattern as demonstrated by x-ray (ab), March, 299

RUSS, S., and SCOTT, G. M.: Resistance to tumour grafts produced by a cell-free tumour extract (ab), April, 440

RUSSELL, DELBERT A., and SMITH, CHARLES D.: Pellegrini-Stieda disease, April, 351

RUSSELL, HOMER B.: See HIRSCH, EDWIN F.

RYDER, HENRY W., and REINEKE, H. G.: Pulmonary roentgenographic changes due to mitral stenosis simulating those due to silicosis (ab), Jan., 91

S

ST. JOHN, FORDYCE B., SWENSON, PAUL C., and HARVEY, HAROLD D.: An experiment in the early diagnosis of gastric carcinoma (ab), Feb., 200

SALPINGITIS. See Fallopiian Tubes

SAMUEL, ERIC: Congenital absence of the pectoralis major (ab), Feb., 203

—See McGRIGOR, D. B.

SANDLER, BERNARD: Principles of treatment of carcinoma cervix uteri by radiotherapy (ab), Jan., 104

SANDSTROM, CARL: On gastrospasm and its roentgenologic appearance (ab), April, 427

SANGUILY, JULIO, and LEON BLANCO, FRANCISCO: Gastric schwannoma: report of large intragastric lesion simulating a bezoar (ab), Jan., 93

SANTULLI, THOMAS V.: See DONOVAN, EDWARD J.

SARA, NATHAN O.: See BACHMAN, ARNOLD L.

SARCOIDOSIS

—Besnier-Boeck-Schaumann syndrome, or benign lymphogranulomatosis, with pneumothoraces; case (ab), James Isbister, Feb., 198

—roentgen therapy of Boeck's sarcoid (ab), Ernst A. Poble, Lester W. Paul, and Elizabeth A. Clark, Feb., 208

SARCOMA

—development of sarcoma in bone subjected to roentgen or radium irradiation (ab), C. Howard Hatcher, Feb., 211

—resistance to tumor grafts produced by a cell-free tumor extract (ab), S. Russ and G. M. Scott, April, 440

Ewing's. See Tumors, Ewing's

reticulosarcoma

—in bones (ab), Thomas Rosendal, June, 620

SAVAGE, OSWALD: Pulmonary concussion ("blast") in non-thoracic battle wounds (ab), Feb., 197

SAVAIN, WILLIAM P.: Congenital absence of the septum pellucidum associated with internal hydrocephalus, March, 270

SCALP. See Ringworm

SCAPHOID BONE, CARPAL

—anomalous fusion of scaphoid and greater multangular bone (ab), M. G. Henry, March, 305

SCATCHARD, GEORGE N., and DUSZYNSKI, DIANA O.: Miniature chest x-ray films in general hospitals (ab), April, 425

SCHARNAGEL, ISABEL M.: See ADAIR, FRANK E.

SCHAUMANN'S DISEASE. See Sarcoidosis

SCHNIEB, ALBERT J.: See GREENBERG, BENJAMIN B.

SCHEPERS, G. W. H.: Pathology of regional ileitis (ab), Feb., 200

SCHERLIS, SIDNEY: Loeffler's syndrome—eosinophilic granuloma. Case report (ab), Feb., 197

SCHLOSSER, JOSEPH V.: See GARCIA, MANUEL

SCHMIER, ADOLF A.: Internal epicondylar epiphysitis and elbow injuries (ab), Feb., 203

SCHMITZ, HERBERT E., SHEEHAN, JOHN F., and TOWNE, JANET E.: Diagnosis and treatment of carcinoma of the fundus uteri (ab), March, 313

—See SHEEHAN, JOHN F.

SCHMITZ, ROBERT C.: Primary atypical pneumonia of unknown cause (ab), Feb., 195

SCHNEIDER, MARTIN: Acrodermatitis: a clinico-roentgenological study (ab), April, 422

SCHORR, S.: See DRUCKMANN, A.

SCHOUP, K.: Plastic induration of the penis (ab), Feb., 210

SCHREK, ROBERT: Studies in vitro on cellular physiology. Effect of x-rays on the survival of cells, April, 395

SCHWANNOMA. See Tumors, neurinoma

SCHWARTZ, CHARLES W.: Solitary myeloma of frontal bone, April, 422

SCIATICA

—protrusions of disks and nerve compression in lumbar region (ab), K. Lindblom, May, 540

SCLEROSIS, TUBEROUS

—characteristic roentgenographic changes associated with tuberous sclerosis (ab), W. W. Dickerson, Jan., 87

SCOTT, G. M.: See RUSS, S.

SCOTT, K. G.: Comparison of two levels of roentgen and neutron irradiation of normal and lymphomatous mice, using radiophosphorus as an indicator of cellular activity, Feb., 173

SCOTT, WENDELL G.: appointment to Board of Reserve Consultants, U.S.N., June, 606

SCOTT, WENDELL G.: Radiographic diagnosis of prolapsed redundant gastric mucosa into the duodenum, with remarks on the clinical significance and treatment, June, 547

SEAR, H. R., and MADDOX, J. K.: Case of Hurler's disease (lipochondrodystrophy) (ab), April, 434

SECOND INTER-AMERICAN CONGRESS OF RADIOLOGY, March, 286

SELANDER, PER: Idiopathic pulmonary hemosiderosis (essential brown induration) (ab), Jan., 91

SELBY, C. D.: Attitude of industry toward x-ray examinations of the chest (ab), May, 533

SELIGMAN, BERNARD, and NATHANSON, LOUIS: "Metastatic" calcification in soft tissues of legs in osteitis deformans: case report (ab), June, 624

SELMAN, JOSEPH. See PENDERGRASS, EUGENE P.

SEMI-LUNAR CARTILAGES

—air arthrography in diagnosis of torn cartilage (ab), E. G. Herzog, June, 624

—roentgen demonstration of cartilages of knee (ab), J. W. Grossman and Howard H. Minor, March, 304

SEMINAL VESICLES

—vaso-seminal vesiculography and its clinical application (ab), Arne Bertelsen and H. H. Wandall, June, 626

SEMMES, R. E.: See WHITELEATHER, J. E.

SEPTUM

pellucidum. See Brain, abnormality

supratrochlear. See Elbow

SHAPIRO, ROBERT: Intracardiac foreign body. Report of case with recovery (ab), May, 535

SHEEHAN, JOHN F., SCHMITZ, HERBERT E., and TOWNE, JANET E.: Changes in the uterus after eradication of endometrial adenocarcinoma by radiotherapy, with particular reference to an infant-like radionecrotic plaque in the lining (ab), Feb., 212

—See SCHMITZ, HERBERT E.

SHEFFERY, JOSEPH B.: Hysterosalpingography as a diagnostic aid in certain types of ruptured uteri (ab), Jan., 100

SHELBURNE, SAMUEL A.: Spontaneous mediastinal emphysema (ab), Jan., 91

SHELDON, WALTER H., THEBAUT, BEN R., HEYMAN, ALBERT, and WALL, MARGARET J.: Osteomyelitis caused by granuloma inguinale: report of case with cultivation of the Donovan body in the yolk sac of developing chick embryo (ab), June, 619

SHELLAC

—chronic exudative and indurative pneumonia due to inhalation of shellac (ab), Edwin F. Hirsch and Homer B. Russell, March, 295

SHELTON, FRED W.: See McREYNOLDS, GEORGE S., Jr.

SHERMAN, LOUISE S.: See HENDERSON, SAMUEL G.

SHOCK

—mechanism of shock from burns and trauma traced with radiosodium (ab), Charles L. Fox, Jr. and Albert S. Keston, April, 440

- SHOULDER**
—calcification of tendon cuff (ab), M. Beckett Howorth, Feb., 203
—roentgenologic considerations pertaining to upper extremity pain (ab), Charles F. Bebbrens, Feb., 209
SICELUFF, JOSEPH G. See **DRAPER, JOHN W.**
SIDEROSIS. See Hemosiderosis; Pneumoconiosis
SIGMOID
—stenosis in newborn (ab), W. R. Bagley and E. C. Bagley, April, 429
—technic of contrast examination (ab), Lars Billing, April, 428
SILICOSIS. See Intestines, volvulus
SILVER FINISHERS
—iron oxide dust and the lungs of silver finishers (ab), A. J. G. McLaughlin, J. L. A. Grout, H. J. Barrie, and H. E. Harding, Feb., 196
SILVERMAN, WILLIAM A. See **CAFFEY, JOHN**
SIMON, R. S. A third routine x-ray exposure of the ankle joint (ab), May, 541
SIMONSON, ERNST. See **ENZER, NORBERT**
SIMSON, F. W. See **DORMER, B. A.**
SINGER, GEORGE, and LAURENCE, GEORGE C. Materials and methods of x-ray protection, Jan., 69
SINGLETERY, WILLIAM V. See **EICHWALD, MAX**
SINUSES, PARANASAL
—See also Frontal Sinus; Maxillary Sinus
—aerosinusitis (ab), R. Wesley Wright and Harold M. E. Boyd, Feb., 193
—aerosinusitis—a resumé (ab), Paul A. Campbell, Jan., 87
SISSON, JOHN H., MURPHY, GEORGE E., and NEWMAN, ELIOT V. Multiple congenital arteriovenous aneurysms in the pulmonary circulation (ab), Jan., 92
SJÖSTRAND, TORNGY. See **BENNER, SVEN**
SKARBY, HANS-GÖSTA. Clinical and roentgenologic diagnosis of foreign bodies, especially fish bones, in the hypopharynx and esophagus, with discussion of a suitable roentgenologic method (ab), March, 298
SKIN
—Albright's syndrome (polyostotic fibrous dysplasia with cutaneous pigmentation in both sexes and gonadal dysfunction in females) (ab), Malcolm B. Dockerty, Ralph K. Ghormley, Roger L. J. Kennedy, and David G. Pugh, April, 433
—diffuse neurofibromatosis (von Recklinghausen's disease) involving the bulbar conjunctiva. Report of case, with lesions of skeletal system and skin, bodily asymmetry and intracranial involvement (ab), Francisco Pérez Allende, Jan., 87
—superficial "burns" of skin and eyes from scattered cathode rays, Laurence L. Robbins, Joseph C. Aub, Oliver Cope, David G. Cogan, John L. Langohr, R. W. Cloud, and Oliver E. Merrill, Jan., 1
—cancer
—slowly developing non-pigmented nevocapithelioma presenting a non-characteristic histologic picture (ab), Jens M. Nordentoft, June, 627
—statistical report, Henry J. Ullmann, March, 279
—multiple cavernous hemangiomas of skin, brain and skeleton: report of case treated by roentgen rays and observed for 7½ years (ab), Ernst A. Pohle and Elizabeth A. Clark, March, 315
SMITH, CHARLES D. See **RUSSELL, DELBERT A.**
SMITH, GEORGE V. S., and DRESSER, R. Carcinoma of the uterine cervix: interval report on treatment, results and complications (ab), June, 628
SMITHERS, D. W. Short esophagus (thoracic stomach) and its association with peptic ulceration and cancer (ab), May, 536
SNITMAN, MAURICE F. Individualization in the management of carcinoma of the maxillary sinus (ab), Jan., 103
SODIUM, RADIOACTIVE. See Radioactivity
SØNDERGAARD, KARL. Passage of contrast substances through the hypopharynx (ab), June, 612
SØRENSEN, FRANZ. Physiological delay at the cardia (ab), June, 617
SOFT TISSUES
—"metastatic" calcification in soft tissues of legs in osteitis deformans: case report (ab), Bernard Seligman and Louis Natanson, June, 624
—roentgenologic soft-tissue studies of skin and subcutaneous tissue: contribution to roentgen study of edema (ab), Arne Frantzell, March, 310
—subcostal swelling of soft tissues in osteochondritis (ab), Knut Lindblom, April, 434
SOHRNE, GUNNAR. Diagnostic use of radioactive common salt (ab), Feb., 207
SOLIS-COHEN, LEON, and LEVINE, SAMUEL. Renal dysplasia (ab), March, 309
SORKIN, REUBEN. See **MONFORT, JOHN**
SOULE, ARTHUR B., JR., GROSS, SIDNEY W., and IRVING, JAMES G. Myelography by use of pantopaque in the diagnosis of herniations of the intervertebral discs (ab), Feb., 202
SPEAR, F. G. Action of neutrons on bacteria (ab), March, 318
—and **TANSLEY, K.** Action of neutrons on the developing rat retina (ab), March, 317
SPENCER, R. R. Problems of cancer biology (ab), Jan., 102
SPIEGLER, G. Photographic methods applied to dosimetric problems (ab), Feb., 211
SPINAL CANAL ROENTGENOGRAPHY
—See also Spine, intervertebral disks
—myelography with abrodil; further experience (ab), Sigfrid Arnell, March, 303
—pantopaque myelography: results, comparison of contrast media, and spinal fluid reaction (ab), William G. Peacher and Robert C. L. Robertson, March, 303
SPINAL CORD
—myelomalacia of cervical portion of spinal cord, probably the result of roentgen therapy (ab), Lewis D. Stevenson and Robert E. Eckhardt, Jan., 105
—intraspinal lipomas. Report of cases, review of literature, and clinical and pathological study (ab), George Ehni and J. Grafton Love, Jan., 102
SPINDLER, HOWARD A. See **HARVEY, ROGER A.**
SPINE
—abnormalities
—interarticular isthmus hiatus (spondylolysis), Henry H. Lerner and Albert I. Gazin, June, 573
—isthmus defects of fifth lumbar vertebra (ab), R. Beverly Raney, Jan., 97
—Klippel-Feil syndrome (congenital synostosis of cervical vertebrae); case (ab), Roald Rinvik, Jan., 96
—two cases of anomaly, best demonstrated by laminaography, John H. Gilmore, Richard C. Stauffer, and Lewis G. Jacobs, May, 514
—Bechterew's disease from roentgenologic point of view (ab), Kristian Overgaard, June, 623
—rheumatoid spondylitis, with special reference to early diagnostic criteria (ab), Arthur J. Present, June, 622
—roentgenologic considerations pertaining to upper extremity pain (ab), Charles F. Bebbrens, Feb., 209
—advantages of supplemental radiographic studies at time of induction (into military service) (ab), A. C. Galluccio, Jan., 89
—diseases of vertebral column: roentgenologic analysis (ab), Albert Oppenheimer, Feb., 202
—incidence of osteochondrosis (ab), S. A. Chrom, June, 622
—roentgenographic observations in age atrophy and osteoporosis of the spine, Gottlieb J. Marum, March, 220
—uncovertebral osteophytes and osteochondrosis of cervical spine (ab), Ernst Lyon, Feb., 202
—dislocations
—spondylolisthesis: commentary on etiology, and an improvement of method of roentgenographic mensuration and detection of instability (ab), Isadore Meschan, Jan., 97
—spondylolisthesis. Further remarks with emphasis on radiologic aspects, A. C. Galluccio, April, 356
—exostoses
—uncovertebral osteophytes and osteochondrosis of cervical spine (ab), Ernst Lyon, Feb., 202
—fractures
—pseudarthrosis following fractures of lumbar transverse processes; case (ab), Geoffrey Hyman, March, 303
—calcification of disks in childhood (ab), H. Stephen Weens, Jan., 97
—disk injury: analysis from industrial standpoint (ab), Henry C. Marble and William A. Bishop, March, 302
—instability associated with disk degeneration in lumbar spine (ab), Folke Knutsson, April, 432
—lateral prolapse of cervical disk (ab), Hugh Davies, Feb., 203
—lesions in relation to pain (ab), A. Craig Mooney, March, 302
—microscopic anatomy and pathology. Part I. Anatomy, development, and physiology. Part II. Changes in disk concomitant with age. Part III. Pathological changes in intervertebral disk (ab), M. B. Covey, R. K. Ghormley, and J. W. Kernoban, April, 431
—myelography by use of pantopaque in diagnosis of herniations of disks (ab), Arthur B. Soule, Jr., Sidney W. Gross, and James G. Irving, Feb., 202
—observations on opaque myelography of lumbar herniations (ab), D. C. Eaglesham, Feb., 202
—pantopaque myelography as an aid in the preoperative diagnosis of protruded disks: preliminary report (ab), Francis A. Echlin, Joseph McK. Ivie, and Archie Fine, Jan., 98
—protrusions of disks and nerve compression in lumbar region (ab), K. Lindblom, May, 540
—roentgenographic signs of herniation of cervical disk, J. E. Whiteleather, R. E. Semmes, and Francis Murphy, March, 213
—role of x-ray in diagnosis of posterior herniation (ab), Arthur E. Childe, April, 431
—tumors
—primary Ewing's sarcoma, Allison B. Imler, Drew B. Melwstrup, and Franklin B. Bogart, June, 597
—wounds and injuries
—roentgen diagnosis of traumatic lesions of cervical spine (ab), Gilbert W. Heublein, Jan., 96
SPONDYLOLISTHESIS. See Spine, dislocations
SPONDYLOLYSIS. See Spine, abnormalities
SPRUE
—clinical significance of alteration of small intestinal pattern as demonstrated by x-ray (ab), Julian M. Ruffin, George J. Baylin, and David Cayer, March, 299
—sprue syndrome; case (ab), James Isbister, March, 300

- SQUIRE, FAY H.** and **KRETSCHMER, HERMAN L.**: Study of the ureters in bladder neck obstructions, Jan., 32
- STAUFFER, RICHARD C.** See **GILMORE, JOHN H.**
- STEBBING, F. G.** See **CADE, STANFORD**
- STEBBING, GEORGE F.** See **CARLING, E. ROCK**
- STEIN, M. H.**: Spontaneous mediastinal emphysema (ab), June, 615
- STEINHAUSEN, T. B.** See **FINE, ARCHIE**
- STEMMERMAN, MARGUERITE G.**: Silexosis of the pericardium. Case report (ab), March, 297
- STEPHENSON, S. K.** See **MEREDITH, W. J.**
- STERILITY**
—hysterosalpingography in sterility (ab), Colin McDonald, Jan., 100
- STERNUM**
—administration of contrast medium in urography via the bone marrow (ab), Lennart Wulldén, May, 541
- STEVENS, D. J.** See **EDDY, C. E.**
- STEVENSON, LEWIS D.,** and **ECKHARDT, ROBERT E.**: Myelomalacia of the cervical portion of the spinal cord, probably the result of roentgen therapy (ab), Jan., 105
- STEWART, FRED W.** See **COLEY, BRADLEY L.**
- STOMACH**
—gastric volvulus and other abnormal rotations of stomach (ab), John B. Hamilton, May, 537
—invagination of stomach: case diagnosed by roentgen examination (ab), Kai Dohn and Børge Faber, June, 617
—physiological delay at cardia (ab), Franz Sørensen, June, 617
—experiment in early diagnosis (ab), Fordyce B. St. John, Paul C. Swenson, and Harold D. Harvey, Feb., 200
—hypertrophic gastritis simulating carcinoma (ab), H. Marvin Pollard and Ralph R. Cooper, April, 427
—localization of gastritis and gastric cancer, especially in cases of pernicious anemia (ab), Johan Torgersen, March, 299
—localized acute edematous gastritis resembling carcinoma. Report of 2 cases (ab), Bengt Sylvén, March, 299
—pathological-anatomical basis of tumor arteriography. Investigation of arterial vessels of hypernephromas and carcinomas of stomach (ab), Lars Billing and Åke G. H. Lindgren, March, 311
—pernicious anemia and the early diagnosis of tumors (ab), Leo G. Rigler, Henry S. Koplan, and Daniel L. Fink, April, 427
—search for symptomless cancer in 500 apparently healthy men of forty-five and over (ob), Morris E. Dailey and Earl R. Miller, June, 617
—short esophagus (thoracic stomach) and its association with peptic ulceration and cancer (ob), D. W. Smithers, May, 536
—examination. See also Stomach, roentgenography
—analytical survey of 1,132 patients gastroscopically examined (ab), Leo L. Hordt, A. Ray Hufford, and J. I. Rabens, April, 426
—experiences with gastroscope over period of six years (ab), John T. Howard, March, 298
—orientation of gastroscope by roentgenograms (ab), A. Ray Hufford and G. G. Stonehouse, Jan., 94
- foreign bodies**
—case of trichobezoar (ab), Gösta Gråberger, April, 428
—gastric schwannoma: report of large intragastric lesion simulating a bezoar (ab), Julio Sanguily and Francisco Leon Blanco, Jan., 93
- hernia**
—hiatus hernia of stomach as source of gastro-intestinal bleeding, Ernest A. Mendelsohn, May, 502
—short esophagus (thoracic stomach) and its association with peptic ulceration and cancer (ab), D. W. Smithers, May, 536
- inflammation**
—chronic hypertrophic antrum gastritis (ab), Julian Arendt, June, 617
—hypertrophic gastritis simulating gastric carcinoma (ab), H. Marvin Pollard and Ralph R. Cooper, April, 427
—localized acute edematous gastritis resembling carcinoma. Report of 2 cases (ab), Bengt Sylvén, March, 299
—localization of gastritis and gastric cancer, especially in cases of pernicious anemia (ab), Johan Torgersen, March, 299
- mucosa**
—radiographic diagnosis of prolapsed redundant gastric mucosa into the duodenum, with remarks on the clinical significance and treatment, Wendell G. Scott, June, 547
- roentgenography**
—gastrosplasm and its roentgenologic appearance (ab), Carl Sandström, April, 427
—new x-ray method of studying anatomy and motility: its diagnostic value (ab), Walter F. Gruber, Feb., 199
—review of 3 cases with positive radiologic and negative laparotomy findings (ab), F. G. Nicholas, March, 299
—with patient under sodium pentothal anesthesia (ab), H. E. Plenge and J. N. Ross, Jan., 94
- tumors**
—gastric schwannoma: report of large intragastric lesion simulating a bezoar (ab), Julio Sanguily and Francisco Leon Blanco, Jan., 93
—roentgen demonstration of benign intramural tumor (fibromyoma) on greater curvature, Alexander Levitan and K. K. Nygaard, June, 390
—ulcers. See Peptic Ulcer
—gastric volvulus and other abnormal rotations of the stomach (ab), John B. Hamilton, May, 537
- STONE, ROBERT S.**, awarded Legion of Merit, May, 523
- STONE, ROBERT S.**: Protection against x-rays and gamma rays. Radiont injury, Jan., 59
—See **LOW-BEER, BERTRAM V. A.**
- STONEHOUSE, G. G.** See **HUFFORD, A. RAY**
- STOWELL, ROBERT E.**: Effects of roentgen radiation on the thymonucleic acid content of transplantable mammary carcinomas (ab), Jan., 106
- STRESS FRACTURE.** See **Femur**
- STRIDOR**
—chronic stridor in early life due to persistent right aortic arch: report of 2 cases (ab), Harold K. Faber, John W. Hope, and Francis L. Robinson, Jan., 92
- STUART, BYRON M.,** and **PULLEN, ROSCOE L.**: Tularemia pneumonia. Review of American literature and report of 15 additional cases (ab), June, 614
- STUART, F. G.**: Pathological manifestations and anatomical variations in pre-enlistment chest roentgenograms (ab), April, 424
- SUBMANDIBULAR GLAND**
—roentgenographic demonstration of concretions in the submandibular glandular duct by use of introral films, George D. Monardo, Jan., 53
- SUBMARINES**
—late bone lesions in caisson disease. Three cases in submarine personnel (ab), C. C. Michael James, June, 621
- SUNDBERG, C. G.,** and **LINDHOLM, STIG:** Formation of layer images in roentgen diagnosis (ab), March, 312
- SUTHERLAND, CHARLES L.,** **PAWCITT, RICHARD,** and **CRAW, JOHN:** Discussion on modern conceptions of industrial lung disease (ab), June, 612
- SVANBERG, TORE:** Roentgenographical pulmonary changes in periarthritis nodosa (ab), Feb., 196
- SWENSON, PAUL C.** See **ST. JOHN, FORDYCE B.**
- SWOPE, OPIE W.** (obit), May, 524
- SYLVÉN, BENGT:** Localized acute edematous gastritis resembling carcinoma. Two cases (ab), March, 299
- SYNDACTYLIA.** See **Fingers and Toes**
- SYNOSTOSIS**
—radiolunar synostosis of traumatic origin: report of case (ob), H. G. Lee, March, 304
- SYPHILIS.** See **Mediastinum; Rectum**
- T**
- TAFT, ROBERT B.**: Protection against x-rays and gamma rays. Human factors, Jan., 65
- TALBOT, NATHAN B.,** **BUTLER, ALLAN M.,** **PRATT, EDWARD L.,** **MACLACHLAN E. A.,** and **TANNHEIMER, J.:** Progeria: clinical, metabolic and pathologic studies of a patient (ab), March, 303
- TANNHEIMER, J.** See **TALBOT, NATHAN B.**
- TANSLEY, K.** See **GLUCKSMANN, A.**
—See **SPEAR, F. G.**
- TAVENER, DIANA R.** See **OSBORN, S. B.**
- TAYLOR, LAURISTON S.**, awarded Bronze Star, Jan., 81
- TEETH**
—cleidocranial dysostosis (with special reference to dental aspects): case (ab), Fred G. Repass, Jan., 96
- TELEROENTGENOGRAPHY.** See **Heart, roentgenography**
- TEMPORAL BONE**
—tumors
—roentgen diagnosis of cholesteatoma (ab), Solve Welin, May, 531
- TEMPOROMANDIBULAR JOINT.** See **Jaws**
- TENDONS**
—calcification of tendon cuff of shoulder (ab), M. Beckett Howorth, Feb., 203
—delayed rupture of extensor pollicis longus tendon following Colles fracture (ab), Donald E. Coburn, March, 304
—tendogenetic disease and its treatment with x-rays (ab), J. Borak, Feb., 208
- TENNENT, WILLIAM:** Plasmocytoma of bone (ab), March, 301
- TESTES**
—malignant tumors (ab), C. H. Frank, March, 315
—excision. See **Castration**
—tumors
—roentgen examination of urinary tract with special reference to methods of examination and findings in individuals with testicular tumors (ab), Joseph C. Bell, Gilbert W. Heublein, and Howard J. Hammer, April, 435
- THAYSSSEN, V.** See **JENSEN, S. HOFFER**
- THEBAUT, BEN R.** See **SHELDON, WALTER H.**
- THOMPSON, C. M.** See **DILLENBERG, S. M.**
- THOMPSON, G. D. CARLYLE.** See **BASS, H. E.**
- THOMS, HERBERT.** See **DUNHAM, ETHEL C.**
- THOMSEN, GREGERS,** and **CHROM, S. A.:** Case of primary lung cancer, presumably arisen from an old tuberculous cavern (ab), June, 613
- THORAX**
—See also **Heart; Lungs; Mediastinum**
—roentgenography
—miniature chest x-ray films in general (ab), N. Seatebard and Diana O. Duszynski, Jan., 59
—nontuberculous lesions found in mass (ab), M. Gould, April, 425
—pathological manifestations and pre-enlistment chest roentgenograms (ab), April, 424
—roentgenograms of chest in mental (ab), Danzer March, 244

- THORAX—cont.**
 —wounds
 —radiology of war injuries. Part III. War wounds of chest (ab), D. B. McGrigor and Eric Samuel, April, 423
- THOREN, S.** Electroendotherapy as an adjuvant to radiotherapy in uterine cancer (ab), Feb., 208
- THORN, GEORGE.** See EDER, HOWARD
- THORNTON, THOMAS F.** See BLOCH, ROBERT G.
- THROMBOSIS**
 —cold isobemagglutinins: their association with hemolytic anemia and multiple thromboses in primary atypical pneumonia. Brief review of the clinical and laboratory problems involved (ab), William R. Platt and Charles S. Ward, Jr., March, 294
- occlusion of superior vena cava due to syphilitic mediastinitis. Collateral circulation after nineteen years (ab), Frederic D. Zeman, June, 615
- THYGESEN, JØRGENSEN, E., VIDEBAEK, AAGE, and VILLAUME.** Treatment of leukemia with artificial radioactive sodium: preliminary report (ab), June, 630
- THYMONUCLEIC ACID.** See Nucleins
- THYMUS**
 —radiographic examination in case (ab), Axel Renander, Feb., 199
- TIBIA**
 —fractures
 —fatigue fracture (ab), H. R. I. Wolfe and J. M. Robertson, June, 625
- fatigue fracture. Three cases at a naval training establishment (ab), Trevor P. Mann, June, 625
- march fracture of the articular surface and its relation to osteoarthritis, Joseph Levitin, March, 273
- paracubite fractures (ab), Paul A. Knepper, May, 541
- solitary eosinophilic granuloma (ab), Benjamin B. Greenberg and Albert J. Schein, Jan., 96
- TINEA.** See Ringworm
- TISCENCO, EUGENE.** See HARPER, R. A. KEMP
- TORGERSEN, JOHAN.** Localization of gastritis and gastric cancer, especially in cases of pernicious anemia (ab), March, 299
- TOTH, BENEDICT J.** The so-called retarded or occult fractures. Significance of the parallel projection in the roentgen diagnosis of fractures (ab), May, 475
- TOWNE, JANET E.** See SHEEHAN, JOHN F.
- TRAUMA**
 —mechanism of shock traced with radiosodium (ab), Charles L. Fox, Jr. and Albert S. Keston, April, 440
- TREVES, NORMAN.** See ADAIR, FRANK E.
- TRICHOZEZOAR.** See Stomach, foreign bodies
- TRICUSPID VALVE**
 —Ebstein type of tricuspid insufficiency: roentgen studies in case with sudden death at age of twenty-seven (ab), Donald deF. Bauer, June, 615
- TROUT, E. D.** See VICTOREEN, J. A.
- TSUKER, MARIE B.** Radiotherapy and intracranial pressure (ab), March, 317
- TUBERCULOSIS**
 —See also Hip; Intestines; Shoulder
 —a new post war public health problem (ab), Edward A. Piszcsek, April, 425
- incidence of extrapulmonary tuberculous infection in fatal pulmonary tuberculosis (ab), R. A. Willis and D. B. Rosenthal, May, 533
- after retrograde pyelography. Report of case (ab), Åke Lindbom, May, 541
- light and x-ray therapy (ab), Edgar Mayer, March, 316
- TUBERCULOSIS, PULMONARY**
 —"beriberi heart" in tuberculous patient (ab), Jason E. Farber and D. K. Miller, Feb., 199
- in World War II (symposium), (ab), Council on Military Affairs and Public Health, American College of Chest Physicians, April, 424
- incidence of extrapulmonary tuberculous infection in fatal pulmonary tuberculosis (ab), R. A. Willis and D. B. Rosenthal, May, 533
- incidence of tuberculosis in Japanese-Americans: a study of a homogeneous racial group (ab), H. E. Bass and G. D. Carlyle Thompson, May, 532
- minimal lesions of lung: their clinical significance (ab), David Reisner and Jean Downes, March, 294
- primary tuberculous infection in sanatorium staff. Investigation and supervision (ab), Peter W. Edwards, A. Clark Penman, and L. G. Blair, Feb., 194
- some cases of intestinal tuberculosis in phthisis, with reference especially to prognosis (ab), S. B. Larsen, June, 618
- artificial pneumothorax in
 —bronchography in pulmonary tuberculosis: artificial pneumothorax (ab), B. A. Dormer, J. Friedlander, and F. J. Wiles, May, 532
- extrapleural pneumothorax in treatment. Three-year to five-year follow-up of 48 cases, F. H. Alley, May, 470
- primary lung cancer, presumably arising from old tuberculous cavern; case (ab), Gregers Thomsen and S. A. Chrom, June, 613
- roentgenology of the draining bronchi from tuberculous cavities, Mortimer R. Camiel, Jan., 24
- in Canadian Army, 1939 to 1944 (ab), J. D. Adamson, W. P. Warner, R. F. Keevil, and R. E. Beamish, Jan., 89
- mass roentgenologic surveys. See also Industry and Occupations; Recruits
 —automatic exposure control in photofluorography (ab), Russell H. Morgan, Feb., 206
- early diagnosis of diseases of chest (ab), Norman J. Wilson, Jan., 89
- experiences with photoroentgen method in chest surveys: analysis of 156,000 examinations (ab), Archie Fine and T. B. Steinhause, June, 612
- hospital fluorophotography: its implications (letter to editor), J. Edwin Habbe, May, 523
- survey of food handlers on the island of Oahu (ab), Joseph E. Ferkany and Richard K. C. Lee, May, 533
- value of stereoscopy in mass radiography, Ira Lewis and Russell H. Morgan, Feb., 171
- roentgenologic surveys
 —bronchography: artificial pneumothorax (ab), B. A. Dormer, J. Friedlander, and F. J. Wiles, May, 532
- bronchography: geographical adventure (ab), B. A. Dormer, J. Friedlander, and F. J. Wiles, April, 425
- surgical therapy
 —mechanical paralysis of left hemidiaphragm complicating collapse therapy (ab), Oscar Feinsilver, Feb., 194
- TULAREMIA**
 —tularemia pneumonia. Review of American literature and report of 15 additional cases (ab), Byron M. Stuart and Roscoe L. Pullen, June, 614
- TUMEN, A. O.** See RACKER, E.
- TUMORS**
 —See also Cancer
 —angioma
 —calcified hemangiomas of liver (ab), Melvin Aspray, March, 301
- lymphangioma of abdomen; unusual case (ab), C. F. Murchbach, E. F. Lewison, and G. A. Deibert, May, 538
- multiple cavernous hemangiomas of skin, brain and skeleton: report of case treated by roentgen rays and observed for 7½ years (ab), Ernst A. Pohle and Elizabeth A. Clark, March, 315
- roentgen therapy of hemangioma of larynx in infants (ab), II. H. Kasabach and C. P. Donlan, Feb., 208
- treatment, G. E. Pfahler, Feb., 159
- treatment of hemangiomas with roentgen rays (nb), James V. Prouty, June, 627
- cholesteatoma
 —roentgen diagnosis of cholesteatoma in temporal bone (ab), Solve Welin, May, 531
- roentgen picture in mucopyoceole and cholesteatoma in frontal sinus (ab), Nils Frostberg, March, 293
- chondroma
 —hamartoma (often called chondroma) of lung (ab), John R. McDonald, Stuart W. Harrington, and O. Theron Clagett, Feb., 198
- multiple chondromata; unusual case, Ramsdell Gurney and Louis Cohen, Jan., 48
- Ewing's
 —primary Ewing's sarcoma of spine, Allison E. Imler, Drew B. Meilstrup, and Franklin B. Bogart, June, 597
- round-cell tumor of bone resembling Ewing's tumor (ab), Robert J. Reeves, March, 313
- fibroadenoma
 —adenofibrosis mammae. Norwegian Radium Hospital's material 1932-1942 (ab), Rolf B. Engelstad and Rolf Weyde, April, 437
- roentgen demonstration of benign intramural tumor (fibromyoma) on greater curvature of stomach, Alexander Lewitan and K. K. Nygaard, June, 590
- giant-cell
 —malignancy of giant-cell tumors: study of giant cell tumors and allied affections in bone, with special reference to their malignancy (ab), Sigurd R. Andersen, June, 620
- roentgen treatment and course of cure of giant-cell tumor in osseous system (10-12 years' cure) (ab), Gösta Jansson, April, 438
- glioma
 —treatment of bilateral retinoblastoma (retinal glioma) surgically and by irradiation. Report on progress (ab), Hayes Martin and Algernon B. Reese, May, 542
- hamartoma. See Tumors, chondroma
- hypernephroma. See Kidneys, tumors
- Krukenberg's. See Ovary, tumors
- lipoma
 —intraspinal lipomas. Report of cases, review of literature, and clinical and pathological study (ab), George Ehni and J. Grafton Love, Jan., 102
- lymphoblastoma
 —of kidney, S. E. Freifeld, May, 507
- comparison of two levels of roentgen and neutron irradiation as an indicator of cellular activity, K. G. Scott, Feb. 173
- dysgerminoma of ovary with widespread metastases, Eugene P. Pendergrass and Joseph Selman, April, 377

TUMORS—cont.

- myeloma
 - isolated myeloma in fourteen year old boy (ab), Justus Kaufman, June, 620
- plasma cell tumors of upper part of respiratory tract (ab), Frederick A. Figg, Albert C. Bruders, and Fred Z. Havens, May, 532
- plasmocytoma of bone (ab), William Tennent, March, 301
- solitary myeloma of frontal bone (ab), Charles W. Schwartz, April, 422
- neurinoma
 - gastric schwannoma: report of large intragastric lesion simulating a bezoar (ab), Julio Sanguily and Francisco Leon Blumco, Jan., 93
- osteoma
 - of frontal sinus: report of 5 cases (ab), Jan., 88
- seminoma
 - dysgerminoma of ovary with widespread metastases, Eugene P. Pendergrass and Joseph Selman, April, 377
- Wilms'. See Kidneys, tumors

TWINS

- identical twins: oochondroplastic dwarfs (ab), S. J. Goodman, April, 435

U

- ULCERS. See Peptic Uleer; Radiations, injurious effects
- ULLMANN, HENRY J.: Cancer of the skin: statistical report, March, 279

ULNA. See Forearm

- UNFUG, GEORGE A.: Comparative clinical investigation of cholecystographic preparations, May, 489

- UNGAR, EMIL: Standardisation of technique in radiotherapy (ab), Feb., 210

URETERS

- study of the ureters in bladder neck obstructions, Fay II. Squire and Herman L. Kretschmer, Jan., 32
- abnormalities
 - anomalies of ureters and kidneys as observed by the radiologist (ab), Bernard H. Nichols, March, 308
 - duplication of right kidney pelvis and ureter with extravescical ureteral opening (ab), Russell J. Moe, March, 308
 - pathologic and anomalous conditions associated with duplication of renal pelvis and ureter (oh), Ruy Goyanna and Laurence F. Greene, May, 541
- cancer
 - primary carcinoma, with special reference to hydronephrosis. Review of literature and report of unusual case (ab), Joseph A. Lazarus and Morris S. Marks, June, 626
 - relationship of epithelial buds to carcinoma of the pelvis of the kidney, ureter and bladder (ab), Albert E. Bothe, Jan., 104

dilatation

- renal hypoplasia with hydronephrosis and primary amenorrhea. Report of case (ab), Frank M. Huff and William P. Boger, Jr., June, 625
- obstruction
 - in children (ab), Charles J. Kiekham, April, 436

URETHRA

- abnormalities
 - accessory channel: case report, E. E. Foog, April, 380
- roentgenography
 - excretory cysto-urethrograms (ab), John W. Draper and Joseph G. Siecluff, Feb., 204

URINARY TRACT

- See also Bladder; Kidneys; Ureters
- calculi
 - preventive treatment of calcium urolithiasis: important role of early and frequent roentgenographic examinations (ab), R. H. Floeks, Jan., 101
- wounds and injuries
 - roentgenological considerations (ab), Arthur P. Echternaecht, April, 436

UTERUS

- changes in uterus after eradication of endometrial adenocarcinoma by radiotherapy, with particular reference to an isofret-like radioneurotic plaque in lining (ab), John F. Sheehan, Herbert E. Schmitz and Janet E. Towne, Feb., 212
- cancer
 - carcinoma of cervix: interval report on treatment, results and complications (ab), George V. S. Smith and R. Dresser, June, 628
 - changes in uterus after eradication of endometrial adenocarcinoma by radiotherapy, with particular reference to an isofret-like radioneurotic plaque in lining (ab), John F. Sheehan, Herbert E. Schmitz, and Janet E. Towne, Feb., 212
 - diagnosis and treatment of carcinoma of fundus (ab), Herbert E. Schmitz, John F. Sheehan, and Janet E. Towne, March, 313
 - electroendothermy as adjuvant to radiotherapy (ab), S. Thorén, Feb., 208
 - improving the results of treatment in cancer of collum of uterus (ab), J. Heyman, April, 437
 - indications and limitations of transvaginal roentgen therapy for cancer of cervix, Arthur W. Erskine, May, 458
 - irradiation failures in early cervical cancer. Improved radiation or return to surgery? (ab), Franz Buschke and Simeon T. Cantril, May, 543
 - present status of diagnosis and treatment of carcinoma (ab), Hugh F. Hare, May, 543

- principles of treatment of carcinoma cervix uteri by radiotherapy (ab), Bernard Sandler, Jan., 101
- problem of secondary infection in carcinoma of cervix, Manuel Garella and Joseph V. Schlosser, May, 448
- treatment of carcinoma of cervix, Juan A. del Regato, June, 579
- fibroma
 - radiation therapy in fibroids (ab), John D. Peake, June, 629
- roentgenography. See Fallopian Tubes, roentgenography
- rupture
 - hysterosalpingography as diagnostic aid in certain types of ruptured uteri (ab), Joseph B. Sheffery, Jan., 100

V

- VAN DEMARK, R. E., and MCCARTHY, PAUL V.: March fracture, May, 496

VARICOSE VEINS. See Extremities**VARIIX. See Esophagus****VAS DEFERENS**

- vaso-seminal vesiculography and its clinical application (ab), Arne Bertelsen and H. H. Wandull, June, 626

- VASTINE, JACOB H., 2d, and VASTINE, MARY FRANCES: Salivaneous urography (ab), March, 307

- VASTINE, MARY FRANCES. See VASTINE, JACOB H., 2d.

VEINS

- vertebral
 - clinical anatomy (ab), Martin Norgore, Feb., 204

VENAE CAVAE

- occlusion of superior vena cava due to syphilitic mediastinitis. Collateral circulation after nineteen years (oh), Frederic D. Zeman, June, 615

VENTRICULOGRAPHY. See Brain, cysticercosis**VESICULOGRAPHY. See Seminal Vesicles****VICTOR, ABRAHAM W. See GOLDMAN, LEONARD B.**

- VICTOREN, J. A., ATLEE, Z. J., and TROUT, E. D.: Behavior of thimble chambers when used for the measurement of very soft radiation (oh), Feb., 211

- VIDEBÆK, AAGE: Singular case of the Plummer-Vinson syndrome (ab), May, 536

- Solitary and multiple carcinomas of upper alimentary tract: their location, age and sex incidence, and correlation with the Plummer-Vinson syndrome (ab), June, 617

—See THYGESEN, JØRGEN E.**VILLAUME, IRGENS. See THYGESEN, JØRGEN E.****VISCERA**

- transposition
 - dextrocardia with situs inversus complicated by chronic rheumatic mitral and mitral endocarditis (oh), George W. Parson, June, 616

VITAMINS

- B
 - clinical significance of alteration of small intestine pattern as demonstrated by x-ray (ab), Julian M. Ruffin, George J. Baylin, and David Coyer, March, 299

D

- evidence of peripheral action of vitamin D from x-ray diffraction studies (ab), C. I. Reed and B. P. Reed, March, 318

- tissue calcification and renal failure produced by massive dose vitamin D therapy of arthritis (ab), T. S. Danowski, A. W. Winkler, and J. P. Peters, June, 624

VOLVULUS. See Intestines; Stomach**VOTTA, PAUL J. See RITVO, MAX****W**

- WAGGONER, IRVING M. See KARPEL, SAUL
- WAGNER, AAGE: Four cases of diaphragmatic intumescence (ab), June, 619

- WAINE, H., BENNETT, G. A., and BAUER, W.: Joint disease associated with macromegaly (ab), March, 305

- WALDENSTROM, JAN: Relapsing, diffuse, pulmonary bleeding or hemosiderosis pulmonum—a new clinical diagnosis (ab), May, 533

- WALDMAN, SAMUEL: Transient heart block in congenital heart disease (ab), May, 535

WALL, MARGARET J. See SHELDON, WALTER H.

- WALLDÉN, LENNART: Administration of contrast medium in urography via the home morrow (ab), May, 541
- On the roentgen diagnosis of space-restricting processes in the small pelvis (ab), April, 430

WANDALL, H. H. See BERTELSEN, ARNE**WAR**

- See also Aviation and Aviators; Military Medicine; Naval Medicine; Recruits

- tuberculosis in World War II (symposium) (ab), Council on Military Affairs and Public Health, American College of Chest Physicians, April, 424

WARD, CHARLES S., Jr. See PLATT, WILLIAM R.**WARNER, W. P. See ADAMSON, J. D.**

- WARREN, SHIELDS: Therapeutic use of radioactive phosphorus (ab), May, 545

WATKINS, CHARLES H. See HALL, BYRON E.

- WATT, JAMES: Effect of deep x-rays on the peritoneal metastases of an ovarian carcinoma (ab), Jan., 104

WEATHERWAX, J. L. See CARDENAS, L.**WECKESSER, E. C. See MCGAW, W. H.**

- WEENS, H. STEPHEN: Calcification of the intervertebral discs in childhood (oh), Jan., 97

WELCH, CECIL CHARLES (obit), April, 414

WELDERS AND WELDING

- clinical physiological observations on welders with pulmonary siderosis and foundry men with nodular uncomplicated silicosis (ab), Norbert Enzer, Ernst Simonson, and A. M. Evans, May, 534
- WELIN, SÖLVE: On the roentgen diagnosis of cholesteatoma in the temporal bone (ab), May, 531
- See ÅKERLUND, ÅKE
- WESTERMARK, NILS: Method for determining the blood pressure in the pulmonary artery (ab), Feb., 205
- On the influence of the intra-alveolar pressure on the normal and pathological structure of the lungs (ab), April, 422
- WEYDE, ROLF. See ENGELSTAD, ROLF B.
- WHITELEATHER, J. E., SEMMES, R. E., and MURPHEY, FRANCIS: Roentgenographic signs of herniation of the cervical intervertebral disk, March, 213
- WHITMORE, WILLIAM H., and PETERSON, GERALD M.: Henoch's purpura: Small intestinal changes. Case report, April, 373
- WIENER, KURT: Cancer treatment with radium bearing moulds (ab), Jan., 103
- WILES, F. J. See DORMER, B. A.
- WILEY, H. M. See ACKERMAN, LAUREN V.
- WILLIS, R. A., and ROSENTHAL, D. B.: Incidence of extra-pulmonary tuberculous infection in fatal pulmonary tuberculosis (ab), May, 533
- WILMS' TUMOR. See Kidneys, tumors
- WILSON, C. W.: Energy absorption in the trunk in the radium treatment of breast cancer by interstitial and surface applicator methods, April, 364
- See GLUCKSMANN, A.
- WILSON, HUGH M., and LUTZ, WALTER G.: Lesions of the aqueduct of Sylvius, Feb., 132
- WILSON, NORMAN J.: Early diagnosis of diseases of the chest (ab), Jan., 89
- WINKLER, A. W. See DANOWSKI, T. S.
- WISSENBERG, PAULA: Dose distribution in rotary irradiation of eccentrically situated axial field as basis for experiments with rotation treatment of cancer of the rectum (ab), May, 546
- WOLFE, H. R. I., and ROBERTSON, J. M.: Fatigue fracture of femur and tibia (ab), June, 625
- WOMACK, NATHAN A. See ALLEN, HARRY
- WOODHALL, BARNES. See McCUNE, WM. S.
- WRIGHT, D. O., and GOLD, EDWIN M.: Loeffler's syndrome associated with creeping eruption (cutaneous helminthiasis) (ab), June, 614
- WRIGHT, R. WESLEY, and BOYD, HAROLD M. E.: Aer sinusitis (ab), Feb., 193
- WRIST
- anomalous fusion of scaphoid and greater multangular bone (ab), M. G. Henry, March, 305

X-Y-Z

- YANG, Y. See KHOO, F. Y.
- ZEMAN, FREDERIC D.: Occlusion of the superior vena cava due to syphilitic mediastinitis. Collateral circulation after nineteen years (ab), June, 615

